3. The Affected Environment

This chapter describes the marine, port, and site environments. Marine environments (Section 3.1) would be potentially impacted by the ocean transport of spent nuclear fuel, and port environments (Section 3.2) would be potentially impacted by the transfer of the casks that would contain the foreign research reactor spent nuclear fuel. The affected environment of the potential DOE management sites for storage is addressed in Section 3.3.

3.1 Marine Environment

The ocean is the principal marine environment potentially impacted by foreign research reactor spent nuclear fuel transport. The scientific study of the ocean is commonly referred to as "oceanography." The discipline of oceanography has been subdivided in terms of the basic physical sciences into geological, chemical, physical, and biological oceanography. The purpose of this section is to provide a basic description of the marine environment. It describes those relevant features that have an influence on the general circulation of the world ocean.

3.1.1 Geological Oceanography

Marine geology or geological oceanography is the study of the character and history of that portion of the earth's surface covered by seawater. The world ocean is geographically divided into five major regions: (1) the Southern Ocean, (2) the Atlantic Ocean, (3) the Pacific Ocean, (4) the Indian Ocean, and (5) the Arctic Ocean. The Pacific Ocean occupies roughly 46 percent of the total world ocean area, the Atlantic Ocean approximately 23 percent, the Indian Ocean nearly 20 percent, and the remaining oceans, 11 percent.

The structural features of the ocean basin surface (Figure 3-1) can be divided into five major entities: (1) shore, (2) continental shelf, (3) continental slope and rise, (4) basin (or abyssal plain), and (5) mid-oceanic ridges. The shore region is commonly referred to as that portion of the land mass that has been modified by oceanic processes. The beach is the seaward limit of the shore, and represents a region that is in dynamic equilibrium between the high and low water marks. Extending seaward from the beach face is the continental shelf. It is characterized by a gentle slope of approximately 1:500. The shelf region has an average width of approximately 65 km (40.4 mi), and a water depth of roughly 130 m (426 ft) at the seaward end of the shelf. The continental shelves provide some of the richest fisheries known. At the end of the shelf, the slope drastically steepens (1:20), giving rise to the continental slope, and eventually the continental rise regions. This region averages approximately 4,000 m (13,120 ft) in vertical extent from the shelf to the abyssal plain. The ocean basin constitutes the most extensive area of the ocean bottom surface. Depths in this region range from 3,000 m to 6,000 m (9,840 to 19,680 ft). About 75 percent of the ocean floor is classified as basin area. The deepest areas of the ocean basins are the deep sea trenches, contrasted by the mid-oceanic ridges, which provide relative high points in the ocean bottom surface topography (Pickard and Emery, 1982).

Marine ports are generally located at the confluence of major rivers and the ocean. These regions are commonly referred to as estuaries, and provide a fragile habitat for much of the marine life found in the oceans. An estuary is defined as a semi-enclosed body of water with a free connection to the open ocean,

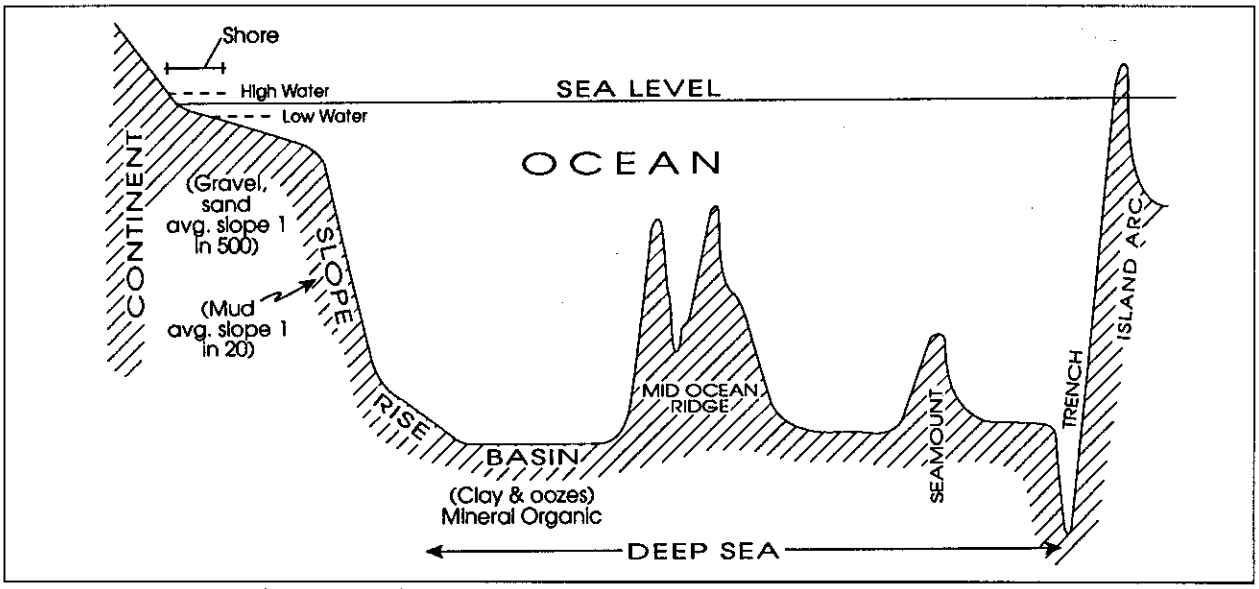


Figure 3-1 Schematic Section Across the Ocean Floor, Depicting Major Geological Features (Pickard and Emery, 1982)

where the saltwater is considerably diluted with freshwater. In general, the freshwater flowing into the estuary eventually exits the system in the upper (water) layer of the estuary, while the denser seawater enters the estuary through lower subsurface layers.

3.1.2 Chemical Oceanography

Seawater is a complex solution of minerals, salts, and elements, containing approximately 80 of the 92 naturally occurring elements. Hydrogen and oxygen, as water, constitute the largest elemental percent of seawater, with sodium chloride (NaCl) being the most abundant salt (78 percent) in the solution. Magnesium, calcium, and potassium chlorides and carbonates provide the bulk of the remaining constituents of the seawater solution. The ratio of these elements within the solution is relatively constant from ocean to ocean. However, in coastal areas where freshwater river influences are significant, the water chemistry can be substantially different. In addition to the major and minor constituents described above, trace metals, nutrient elements, dissolved atmospheric gases, and other organic matter also form important components of seawater. While trace metals are essential to the growth and development of certain organisms at low concentrations, these elements can become toxic when concentrated at high levels. Table 3-1 summarizes the concentration of major elements and trace elements, expressed in milligram per liter (mg/L), in seawater. The major nutrients (phosphates, silicates, and nitrates) provide the chief limiting agent for oceanic phytoplankton production. Atmospheric gases (e.g., oxygen and carbon dioxide) absorbed by the ocean play important roles in the overall global climate of the earth.

Naturally occurring radionuclides of uranium (such as ^{234}U, ^{235}U, ^{238}U), and polonium-210 (^{210}Po), are present in seawater, and in marine organisms, at concentrations generally greater than those found in terrestrial ecosystems. The ocean water concentrations of uranium isotopes are: ^{234}U, 1.30 picocuries per liter (pCi/l); ^{235}U, 0.05 pCi/l; and ^{238}U, 1.2 pCi/l (IAEA, 1976). For comparison, other major radioisotopes found in ocean water are: potassium-40 (40K), 486 pCi/l; thorium-232 (232Th), 540 pCi/; tritium (3H), 3 pCi/l; rubidium-87 (87Rb), 3 pCi/l; and Carbon-14 (14C), 1.8 pCi/l (IAEA, 1988).

Table 3-1 Concentration of Major Elements and Trace Elements in Seawater (CRC, 1991)

Element	*mg/L*	*Trace Element*	*mg/L*
Chlorine	19,000	Strontium	8.1
Sodium	10,500	Arsenic	0.003
Magnesium	1,350	Iron	0.01
Sulphur	885	Copper	0.003
Calcium	400	Zinc	0.01
Potassium	380	Cesium	0.0005
Bromine	65	Uranium	0.003
Fluorine	1.3	Lead	0.00003
Iodine	0.06	Zirconium	0.000022

The relationship between environmental concentrations of radionuclides and the concentration found in organisms is important in the study of food chain effects. Bioamplification, the increase in concentration of radionuclides in organisms progressively further up the food chain (as with organic pesticides in terrestrial environments), is observed in marine food chains. In the marine environment, uranium has not been found to bioamplify in fish, and there is only slight bioamplification in crustaceans and mollusks (IAEA, 1976). The readiness with which other radionuclide constituents of spent nuclear fuel may enter the food chain is variable, but generally low.

3.1.3 Physical Oceanography

The science of physical oceanography involves the development of a systematic quantitative description of ocean characteristics and circulations. Ocean circulations include not only the major, permanent ocean features (e.g., the Gulf Stream) that circulate continuously with fluctuating velocity and position dynamics, but also the smaller-scale circulation features (e.g., tides, waves, coastal currents, etc.). Gradients in temperature, salinity, and seawater density give rise to vertical and lateral circulations.

The primary forces behind the generation and maintenance of surface currents in the world ocean are the winds in the lower portions of the atmosphere. Low-level winds generate stresses on the ocean surface that give rise to the surface currents. However, these currents only affect the uppermost layers of the ocean. Thus, the global wind patterns establish the direction and magnitude of the surface currents. Figure 3-2 depicts the major components of the wind-induced surface circulation of the world ocean.

Northern hemisphere ocean basins are characterized by strong western basin boundary currents that transport warmer, less dense water poleward, and are balanced by weaker, colder return flows along the eastern basin boundaries. Examples of these flows in the northern hemisphere are the Gulf Stream and Kuroshio currents, and the Canary and Californian currents, respectively. These permanent circulation features are the result of the strong mid-latitude westerly winds and the easterlies in the tropics. Due to the strength of these oceanic and atmospheric circulations, North Atlantic and North Pacific shipping routes tend to follow these flows.

Also of interest are the deep water convective circulations, which are linked with the surface system circulation. In general, these circulations are generated in high latitudes by air-sea interaction processes producing relatively cold and dense surface waters that sink and flow into the central ocean basins. This loss of water in the high latitudes is replaced by warmer surface waters migrating poleward at intermediate depths. Thus, in considering the overall environmental impact of the proposed and alternative actions, the intermediate and bottom water masses/circulations cannot be ignored, due to their surface origin.

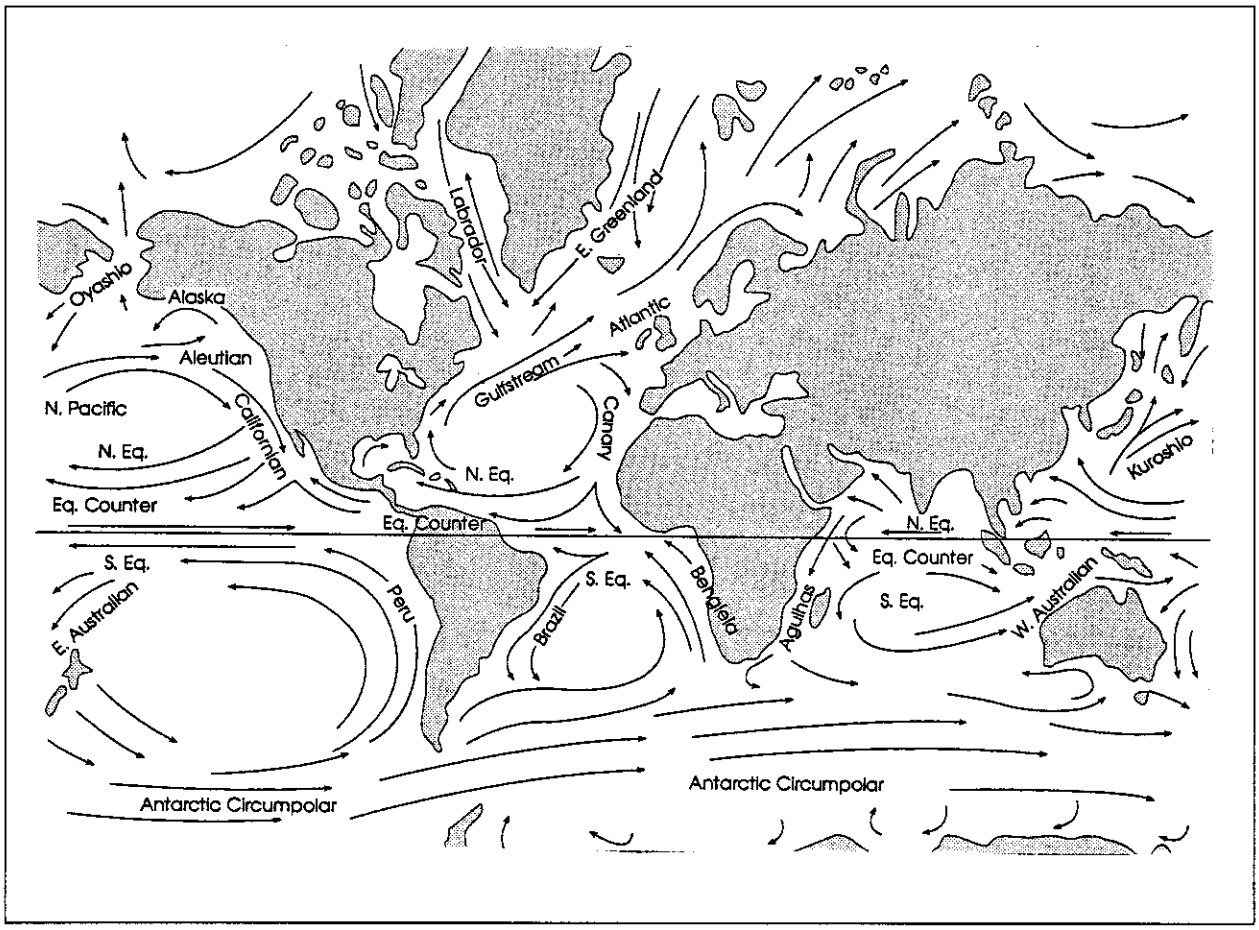


Figure 3-2 Major Wind-Driven Surface Currents of the World Ocean (Kennett, 1982)

3.1.4 Biological Oceanography

Biologically, the characteristics of ocean organisms dramatically change with ocean depth. Changes in organisms can be correlated with the decrease in the amount of light and the wavelength of the light that penetrate to a given depth. This variation in light is also influenced by the turbidity of the oceanic waters, and has a great influence on the biological productivity of a given region. Upper water layers are rich in nutrients and more productive than water layers found at depths greater than 200 m (660 ft). Abundant plant life supports the many animal species found at depths less than 200 m (660 ft). The estuarine areas found at the margins of the shelf region and the continents provide rich, productive breeding and spawning grounds for many marine organisms. In contrast, the deep ocean bottoms are limited in productivity because of the absence of light and the scarcity of nutrients (Friedrich, 1969).

The deep sea bottom dwellers are highly diverse, with many biological groups represented by more species than in most shallow-water communities (Hessler and Sanders, 1967). However, the number of individual organisms in a given volume does decrease in the deep sea and this, together with a general tendency toward decrease in the average size of the organisms, results in a dramatic reduction in standing stock or biomass on the deep ocean floor. In round figures, the total wet weight of bottom-living organisms in and on each square meter (m) of seabed decreases from 10-100 grams (g) on the continental shelf, to 1-10 g on the continental slope, and to only 0.1-1.0 g on the abyssal plain (Rice, 1978).

3.2 Individual Port Marine Environments

This section presents general environmental information for ten U.S. ports that have been identified as potential ports of entry. The ten ports are:

> Charleston, SC [includes the Naval Weapons Station (NWS) at Charleston and the Wando Terminal]; Galveston, TX; Hampton Roads (includes terminals at Newport News, Norfolk, and Portsmouth), VA; Jacksonville, FL; the Military Ocean Terminal at Sunny Point (MOTSU), NC; the NWS at Concord, CA; Portland, OR; Savannah, GA; Tacoma, WA; and Wilmington, NC.

These ports are more fully described in Appendix D of this Environmental Impact Statement (EIS). Appendix D identifies the ports that were considered as potential ports of entry for foreign research reactor spent nuclear fuel, the criteria used in the port evaluation process, the method of evaluation, and the results of the evaluation process. Appendix D also presents population data for ports and transportation routes considered in the evaluation. Potential overland and barge transportation routes are described in Appendix E, and Appendix C presents information on the environmental impacts of marine transport.

The various policy, management, and implementation alternatives being considered in this EIS do not involve any construction or modification of port facilities, nor would the use of one or more ports for the receipt of foreign research reactor spent nuclear fuel be expected to noticeably increase the number of vessel calls to the port or interfere with existing port operations. Once at the port of destination, the spent nuclear fuel would be transferred from the vessel to a waiting truck or train and shipped to the destination as expeditiously as possible.

3.2.1 Environmental Information for the Potential Ports of Entry

This section presents summary environmental information for the potential ports of entry for foreign research reactor spent nuclear fuel.

3.2.1.1 Charleston, SC (Includes Terminals at the Naval Weapons Station and the Wando Terminal)

Charleston is the largest port city in South Carolina, and the greater Charleston area is one of the major seaports on the East Coast of the United States. The city of Charleston is located at the confluence of the Cooper and Ashley Rivers, approximately 11 km (7 mi) west of the Atlantic Ocean. The principal wharves are along the west bank of the Cooper River, except for the Wando Terminal, which is along the east bank of the Wando River near the city of Mount Pleasant, about 20 km (12 mi) from the Atlantic Ocean. The city of Charleston is on a peninsula, bounded on the west and south by the Ashley River and on the east by the Cooper River. In general, the elevation of the area ranges from sea level to approximately 6 m (20 ft) on the peninsula.

Environmental Conditions: The State of South Carolina has classified the water quality of the lower portion of the Wando River as both SFH and SA (SFH waters are shellfish harvesting waters, and SA waters are suitable for primary and secondary recreation and for other water uses requiring lower water quality). According to the U.S. Fish and Wildlife Service's Ecological Inventory Map for James Island, SC, the Wando Terminal and the NWS Charleston are located in a mid-salinity estuarine habitat (generally 5 to 16.5 ppt). The Charleston harbor which is traversed enroute to either terminal, is located in a high-salinity estuarine habitat (generally 16.5 to 30 ppt) (FWS, 1980a).

The State of South Carolina has classified the water quality of the portion of the Cooper River above the confluence with the Ashley River as SB (SB waters are tidal saltwaters suitable for secondary contact recreation, crabbing, and fishing, except the harvesting of clams, mussels, or oysters for market purposes and human consumption). The waters of Goose Creek, upstream of the confluence with the Cooper River to the dam at the Charleston Waterworks, are also Class SB (Department of the Navy, 1994).

State or Federally protected endangered or threatened aquatic species in the vicinity of the Charleston harbor include the shortnose sturgeon, Atlantic sturgeon, and the American shad. Bachman's warbler is a Federally protected bird species also found in the vicinity (FWS, 1980a). While there are some wetlands in the vicinity of Wando Terminal and on the property of NWS Charleston (Department of the Navy, 1990 and 1994), there are no known special wildlife sanctuaries or habitats of concern in the general area. Bald eagles have been observed on the NWS Charleston property and are believed to be nesting in the far northern areas of the Station. Red-cockaded woodpeckers are known to inhabit NWS Charleston. Although, the hurricane Hugo (September 1989) destroyed much of their habitat (mature pine trees with red heart disease), several colonies are surviving with the assistance of artificial nest bates (Lewis, 1995). The Charleston harbor area and the west bank of the Cooper River are commercially well developed.

The lower Wando and Cooper Rivers and the Charleston harbor support a large number of aquatic and terrestrial species. Aquatic species commonly found in the vicinity include crabs, oysters, clams, shrimp, sturgeon, herring, shad, seabass, kingfish, drum, flounder, and mackerel. Marine mammals, including dolphins and whales, have been sighted in the harbor. According to the South Carolina Heritage Trust, no rare, threatened, or endangered species or communities have been recorded in the area near the Wando Terminal (McBee, 1994).

Climatic Conditions: The climate of this region is temperate, primarily due to its close proximity to the Atlantic Ocean. The prevailing winds are generally northerly in the fall and winter months, becoming more southerly during the summer months. This type of circulation serves to "warm" the region during winter and "cool" it during the summer. Summer is the rainy season in Charleston, with the city receiving 41 percent of the annual total rainfall during the summer months. Except for the occasional tropical storm or hurricane, the majority of this rain occurs during afternoon and evening thunderstorms. The late summer and early fall brings the highest probability of tropical storm activity to the Charleston area. The fall season is a transitional period, where temperature extremes are rare and sunshine is abundant. The winters in this area are mild with periods of rain. However, in contrast to the summer, winter rains tend to be steady and uniform, and last for several days. The most unstable period in this region is spring, when the confluence of warm moist tropical air and cool dry continental air increase the occurrence of severe weather in this region. The average earliest freeze is in early December, and the average last frost is in late February (NOAA, 1992c).

The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Charleston, the Uniform Building Code provides a basic wind speed of about 160 km per hour (100 m per hour). The greater Charleston area is located in a moderate seismic zone with an acceleration of 0.15 g. The effective peak velocity-related acceleration represents the back-and-forth horizontal motion of the ground due to a seismic event at a period of 1.0 sec. This acceleration is expressed in relation to g, where g equals acceleration due to gravity.

Naval Weapons Station - Charleston: The NWS is located on the west bank of the Cooper River, north of the city of North Charleston. The NWS is approximately 7080 hectares (17,500 acres) in size and is located in southeastern Berkely County, South Carolina, about 30 km (19 mi) from the Atlantic Ocean. The NWS has two useful wharves and two useful piers. Wharf Alpha and Pier Bravo have cranes and are

capable of loading trucks or trains directly from the ships. Pier Charlie and the Military Traffic Management Command Terminal would have to use shipboard or mobile cranes to load trucks. Several facilities on the NWS could be used to transfer spent fuel casks or containers from trucks to rail cars. A map of the port is shown in Figure 3-3.

The 1990 population within 16 km (10 mi) of the Wharf Alpha was 209,188. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five U.S. Department of Energy (DOE) management sites are: the Savannah River Site, 46,200; the Oak Ridge Reservation, 108,000; the Idaho National Engineering Laboratory, 498,000; the Hanford Site, 550,000; and the Nevada Test Site, 540,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 303 km (188 mi), the Oak Ridge Reservation, 647 km (402 mi), the Idaho National Engineering Laboratory, 3,930 km (2,442 mi), the Hanford Site, 4,601 km (2,859 mi), and the Nevada Test Site, 4,094 km (2,544 mi). Distances along rail routes are slightly longer.

Ethnic and Income Characteristics: Figure 3-4 shows the ethnic composition for the area surrounding the port at the NWS Charleston. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans constituted about 31 percent of the total population, and approximately 88 percent of the minority population for the area surrounding the port. Figure 3-5 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

Wando Terminal: This South Carolina State Port Authority terminal is located at the confluence of the Wando and Cooper rivers, on the east bank of the Wando River, near the incorporated city of Mount Pleasant. The facility has three modern container berths, with a fourth under construction, and a large paved container storage yard. The Wando terminal is about 8.1 km (5 mi) from the nearest Interstate highway and 15 km (9 mi) from the nearest intermodal rail yard. A map of the port is shown in Figure 3-6.

The 1990 population within 16 km (10 mi) of the Wando Terminal was 233,424. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five U.S. Department of Energy (DOE) management sites are: the Savannah River Site, 65,700; the Oak Ridge Reservation, 127,000; the Idaho National Engineering Laboratory, 518,000; the Hanford Site, 569,000; and the Nevada Test Site, 559,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 327 km (203 mi), the Oak Ridge Reservation, 671 km (417 mi), the Idaho National Engineering Laboratory, 3,954 km (2,457 mi), the Hanford Site, 4,625 km (2,879 mi), and the Nevada Test Site, 4,118 km (2,559 mi). Distances along rail routes are slightly longer.

Ethnic and Income Characteristics: Figure 3-7 shows the ethnic composition for the area surrounding the Wando Terminal. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans constituted about 33 percent of the total population, and approximately 93 percent of the minority population for the area surrounding the port. Figure 3-8 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

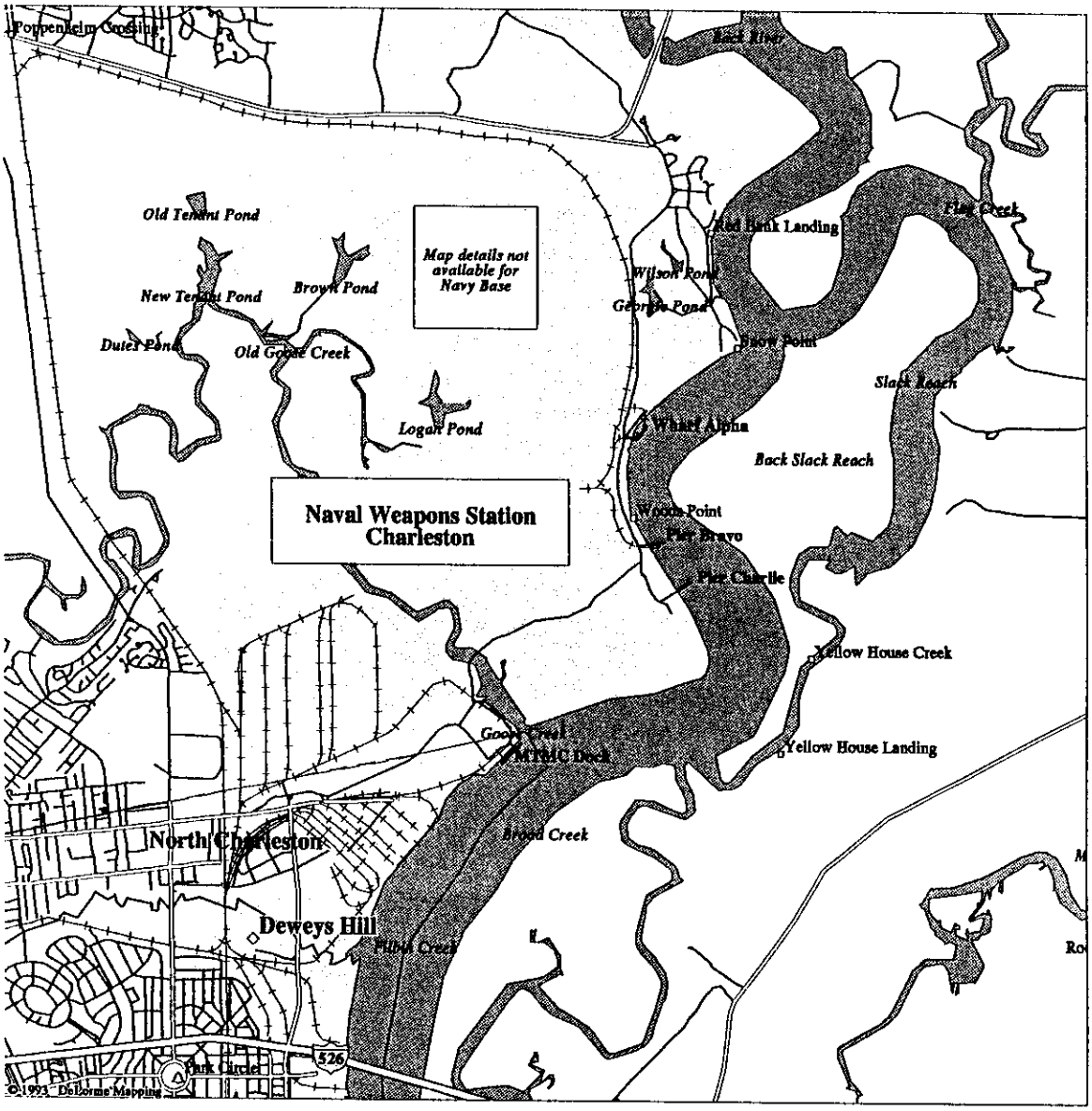


Figure 3-3 Naval Weapons Station, Charleston, SC

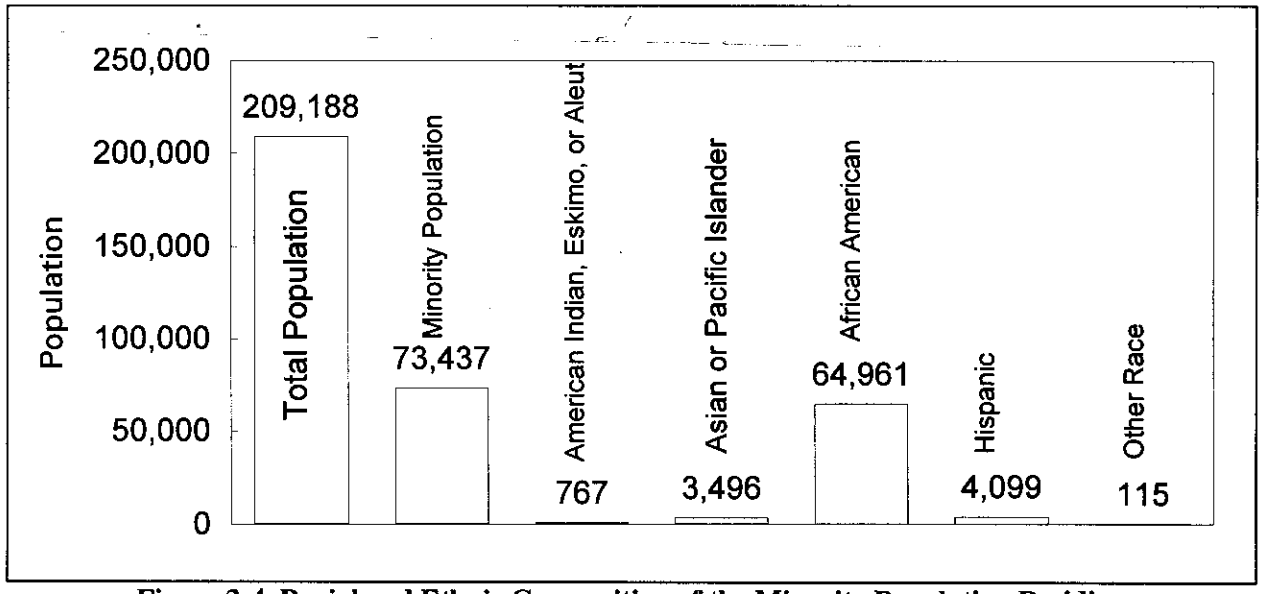


Figure 3-4 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Naval Weapons Station, Charleston

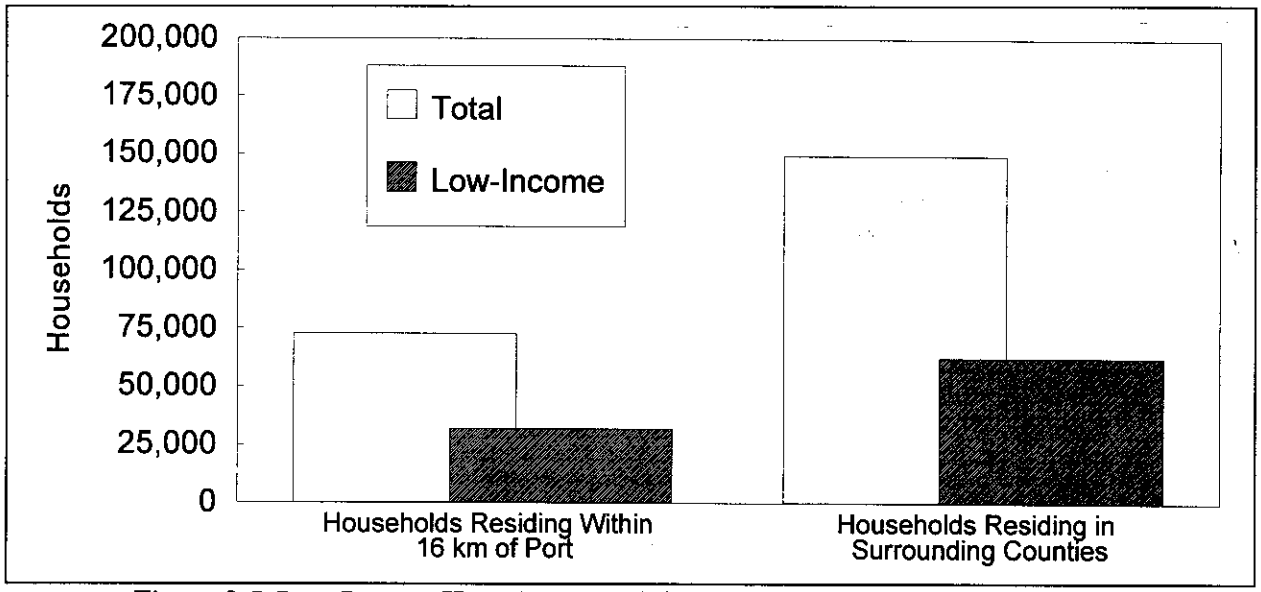


Figure 3-5 Low-Income Households Residing within 16 km (10 mi) of the Naval Weapons Station, Charleston

3.2.1.2 Galveston, TX

Galveston, TX is situated within 16 km (10 mi) of the entrance to the Gulf of Mexico. The city of Galveston occupies the entire width of the east end of Galveston Island. The shipping wharves are on the north side of the island and the Gulf of Mexico is on the south. The Port of Galveston is located in the heart of the city. A map of the port is shown in Figure 3-9.

Galveston is a major resort and tourist center for the Southwest. There is a waterfront tourist attraction at "Pier 21" close to the port area. A public park on Pelican Island, reached by causeway, is located across the Intracoastal Waterway from the Port of Galveston. A cruise ship terminal is located at Pier 25 in the

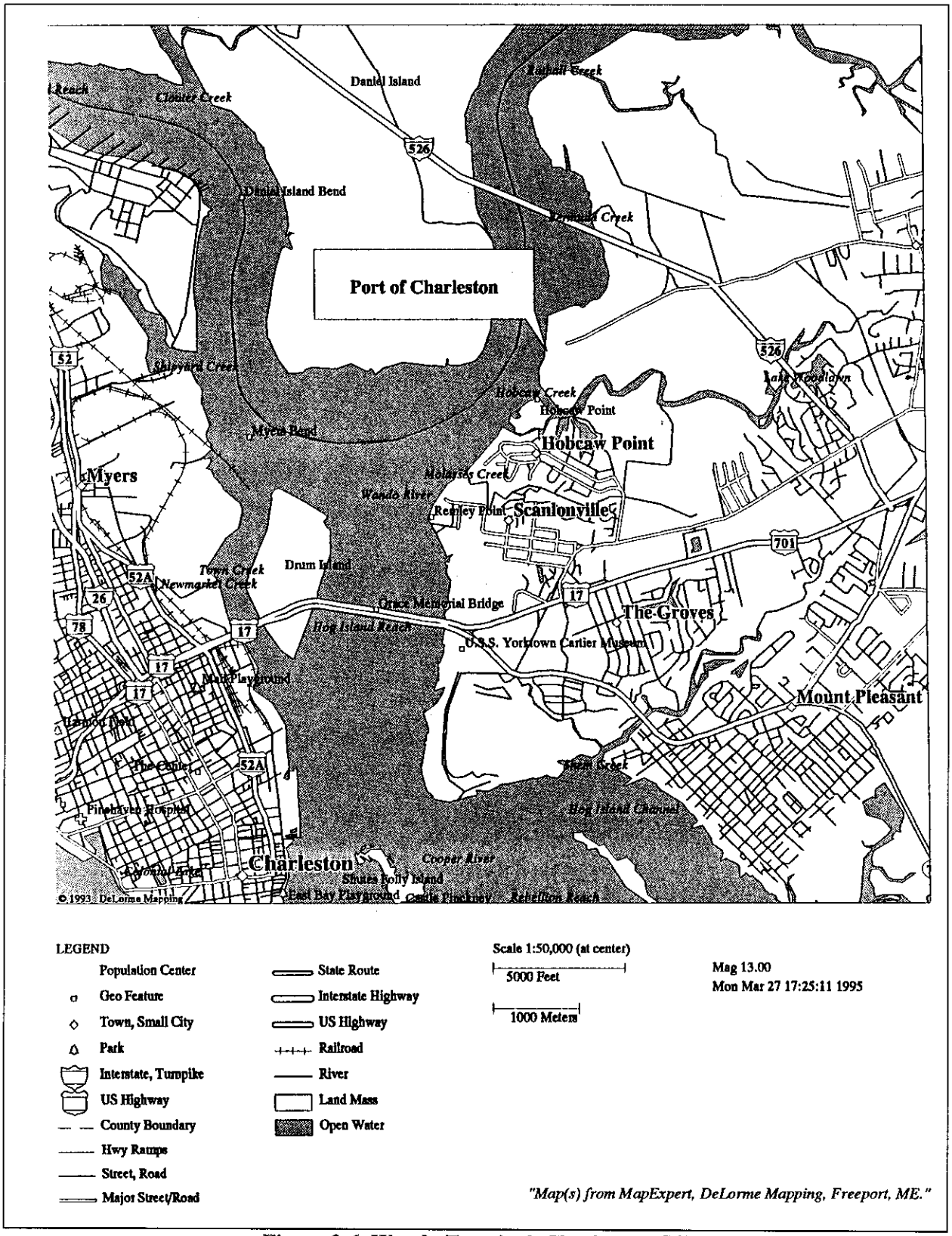


Figure 3-6 Wando Terminal, Charleston, SC

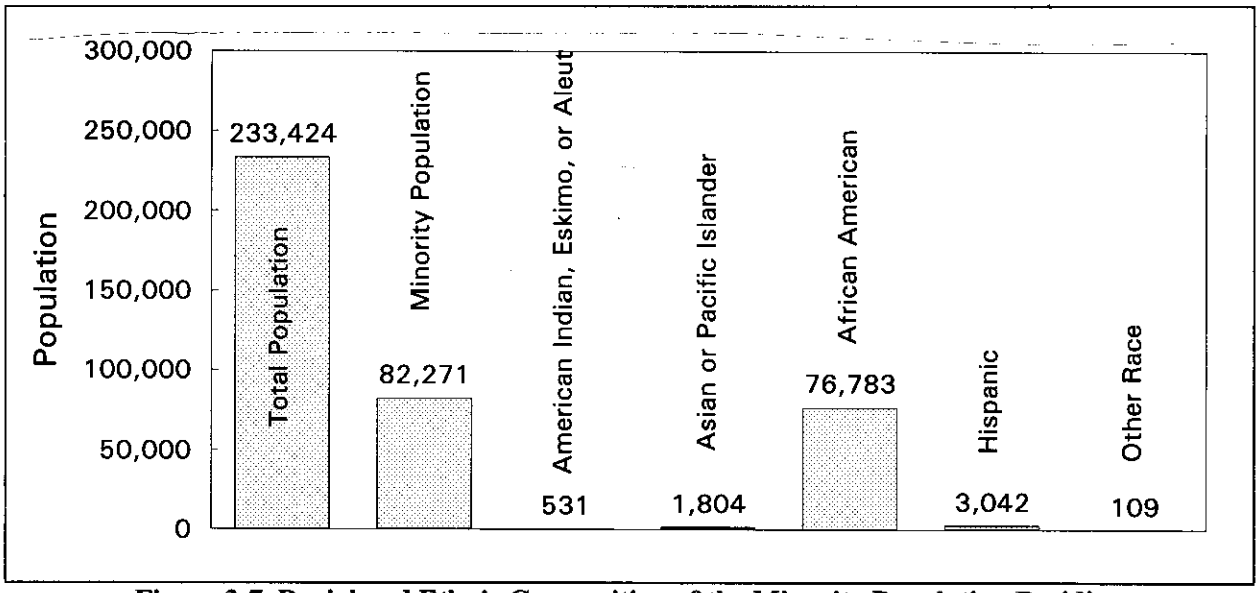


Figure 3-7 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Wando Terminal, Charleston

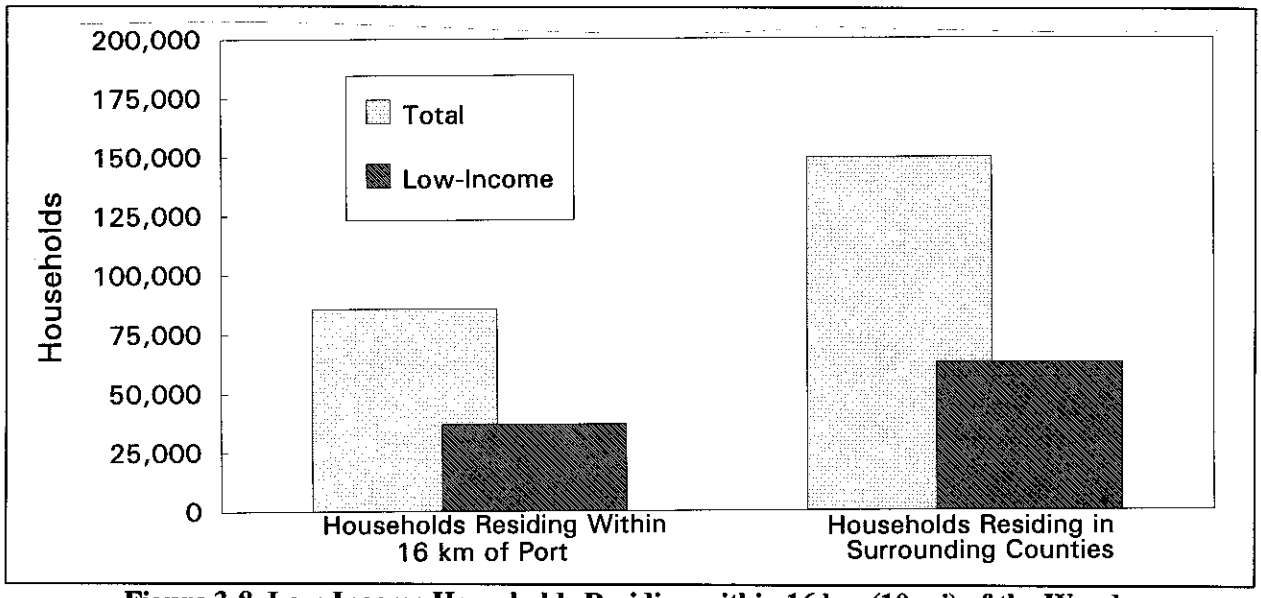
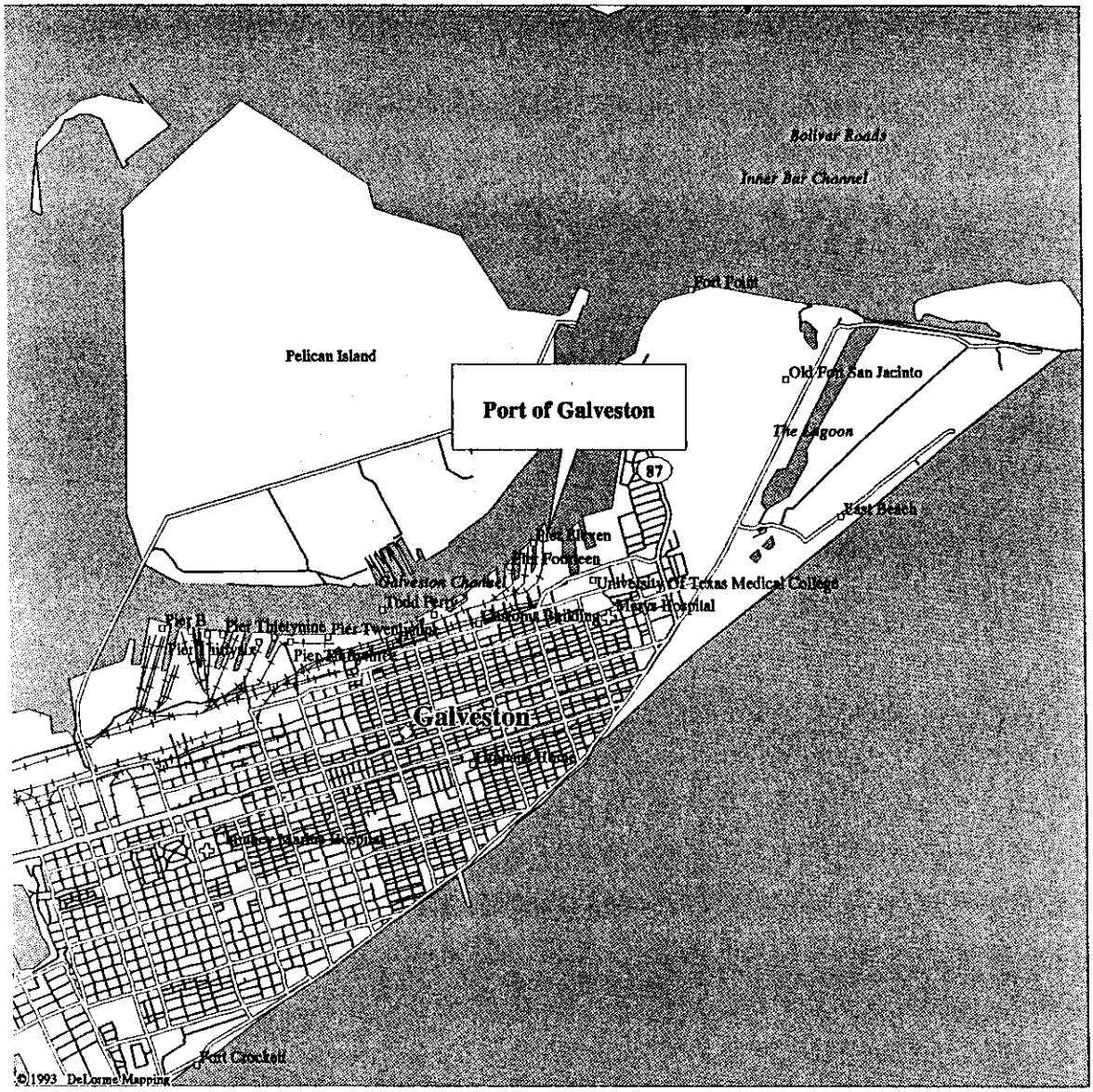


Figure 3-8 Low-Income Households Residing within 16 km (10 mi) of the Wando Terminal, Charleston

heart of the Port of Galveston complex, and there is a tanker terminal on Pelican Island across from the Port of Galveston at its southern end. A Federal project provides for an entrance channel, and an outer bar channel both dredged to 12.8 m (42 ft).

The Port of Galveston's principal container handling facility is the container terminal at Pier 10. This facility has a controlled all-weather truck entrance and interchange area. The terminal is connected to Interstate Highway 45 on the mainland by a 9.3 km (5.8 mi) four-lane State highway and two 2.8 km (1.75 mi) causeways that cross the southwest end of Galveston Bay. The container handling facility is served by four major railroads, the Burlington Northern, Santa Fe, Southern Pacific, and Union Pacific



LEGEND

- Population Center
- State Route
- Geo Feature
- Large City
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River
- Open Water

Scale 1:50,000 (at center)

5000 Feet

1000 Meters

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"Map(s) from MapExpert, DeLorme Mapping, Freeport, ME."

Figure 3-9 Port of Galveston, TX

Lines. Galveston Railway, Inc., provides terminal connections and performs switching of all port rail traffic. An intermodal container transfer terminal is located within the container terminal, and trackage extends to within 30.5 m (100 ft) of ship berths.

The 1990 census population within 16 km (10 mi) of the port terminals was 73,322. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 403,000; the Oak Ridge Reservation, 337,000; the Idaho National Engineering Laboratory, 526,000; the Hanford Site, 575,000; and the Nevada Test Site, 595,000. Populations along rail routes to these sites are slightly larger for the Savannah River Site and the Oak Ridge Reservation, but slightly less for the Idaho National Engineering Laboratory, the Hanford Site, and the Nevada Test Site. The distances to the five potential sites on interstate routes are: the Savannah River Site, 1,600 km (1,000 mi); the Oak Ridge Reservation, 1,550 km (963 mi), the Idaho National Engineering Laboratory, 3,070 km (1,908 mi); the Hanford Site, 3,740 km (2,324 mi); and the Nevada Test Site, 3,000 km (1,864 mi). Distances along rail routes are slightly longer.

Environmental Conditions: A large number of aquatic and terrestrial species frequent the Galveston Bay area. A variety of birds migrate, winter, and breed along the Texas Coast including shorebirds, songbirds, waterfowl and raptors (Breslin, 1993; FWS, 1992). These endangered/threatened bird species include the brown pelican, peregrine falcon, bald eagle, Atwater's greater prairie-chicken, piping plover, and the Eskimo curlew (State-threatened only). Endangered/threatened marine mammals and sea turtles also are found in the coastal bay systems and the Gulf of Mexico. Galveston Bay is within the range of the green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. While no protected species are known to be located within the Port of Galveston, significant populations of the endangered brown pelican and the threatened piping plover exist nearby (Werner, 1994). The U.S. Fish and Wildlife Service reported that as many as 600 brown pelicans have been sighted loafing on the north end of Little Pelican Island, which is approximately 5.6 km (3.5 mi) northwest of the port. In addition, approximately 125 pairs nested and produced 90 young ones at this site in 1994. This was the first time that brown pelicans had successfully nested in Galveston Bay in over 40 years. Wintering populations of the threatened piping plover use the northeastern end of Galveston Island and the southeastern end of Bolivar Peninsula. Of the 3,187 birds observed during the first Gulf Coast count of wintering piping plovers, 1,904 were observed on the Texas coastline (Werner, 1994).

A great amount of commercial and recreational fishing occurs in Galveston Bay and the Gulf of Mexico. Shellfish are the most important commercial species, particularly shrimp followed by eastern oysters and blue crabs (TPWD, 1989a). The most valuable finfish landed from the Galveston Bay system are black drum and mullet. In 1988, a total of 507,7169 kg (11,169,773 lb) of shellfish valued at $13,489,146 was landed from the Galveston Bay System; a total of 224,536 kg (493,980 lb) of finfish valued at $226,140 was also landed. The major recreational species of fish that were caught in the Galveston Bay system in 1987-1988 were: Atlantic croaker, sand seatrout, spotted seatrout, southern flounder, black drum, and red drum (TPWD, 1989b). Galveston Bay has been named as an "estuary of national significance" by the U.S. Congress. The implementation of the proposed action would pose no significant radiological or non-radiological risks to the environment in the Galveston area, including estuaries.

Climatic Conditions: The climate of the Galveston area is predominantly marine, with periods of modified continental influence during winter. The port is subject to hurricanes and tropical storms (NOAA, 1993a). The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. For the Port of Galveston, the Uniform Building Code provides a basic wind speed of about 160 km per hour (100 mph) (UBC, 1991). The port is located in a very low seismic zone with an acceleration of less than 0.075 g.

Ethnic and Income Characteristics: Figure 3-10 shows the ethnic composition for the area surrounding the Port of Galveston. This figure shows the population residing within 16 km (10 mi) of the port, according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 27 percent of the total population, and approximately 54 percent of the minority population for the area surrounding the port. Hispanics made up about 20 percent of the total population, and approximately 40 percent of the minority population around the port. Figure 3-11 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

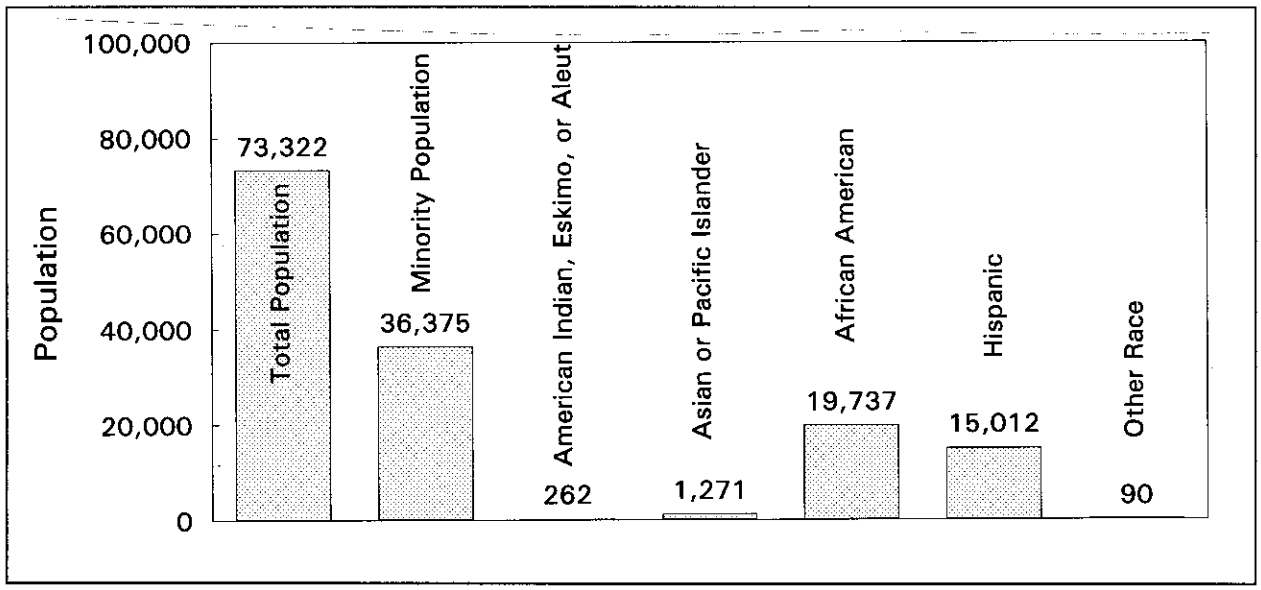

Figure 3-10 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Galveston

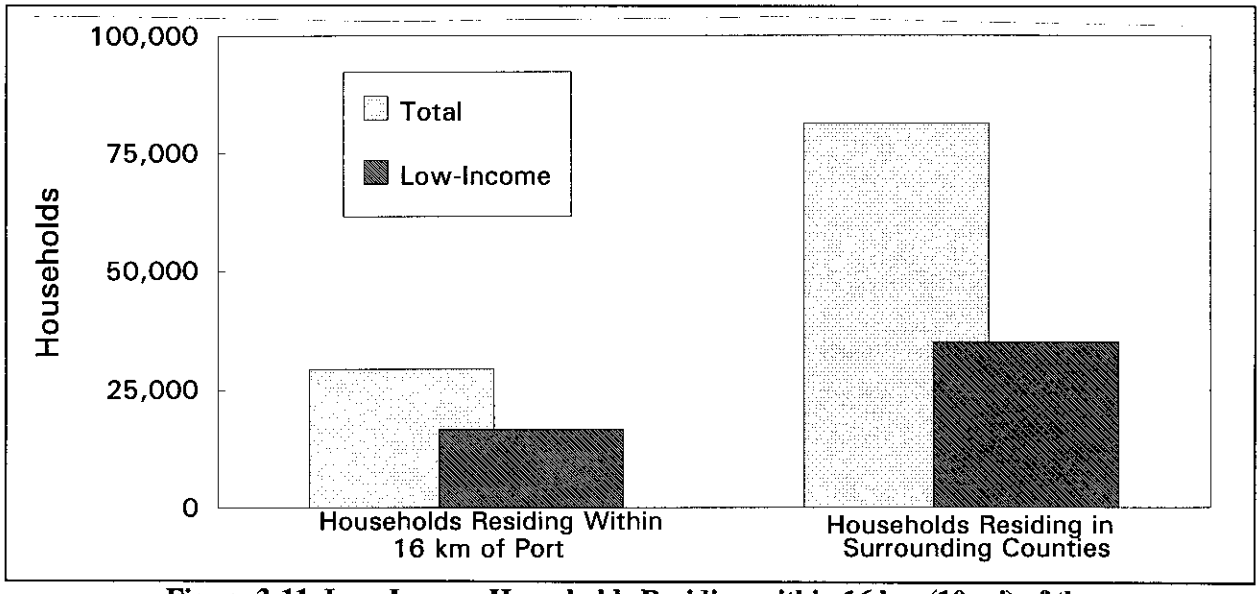

Figure 3-11 Low-Income Households Residing within 16 km (10 mi) of the Port of Galveston

3.2.1.3 Hampton Roads, VA (Includes Terminals at Newport News, VA; Norfolk, VA; and Portsmouth, VA)

Hampton Roads is one of the world's foremost bulk cargo harbors, and has more collective experience handling spent nuclear fuel than any other port in the United States. It is a multi-terminal port with privately and publicly owned marine cargo handling facilities, and is located at the southwest corner of the Chesapeake Bay at the confluence of the James and the Elizabeth Rivers. The port is about 26 km (16 mi) from the Virginia Capes and the entrance from the Atlantic Ocean. The major terminals located on the Elizabeth and James Rivers are approximately another 10 to 13 km (6 to 8 mi) from the Chesapeake Bay. The port includes the port terminals at Norfolk, Portsmouth, and Newport News. All three terminals are located in commercial port districts of their respective cities, somewhat separated from other community activities, in areas dedicated primarily to port industrial usage. Adjacent communities include the cities of Chesapeake and Virginia Beach.

Environmental Conditions: The Port of Hampton Roads is located at the confluence of the James River and the Chesapeake Bay, approximately 29 km (18 mi) west of the Atlantic Ocean. The average elevation of this region is approximately 4 m (13 ft) above sea level. There are no known areas of special environmental concern other than the growing interest in preservation of the Chesapeake Bay and its tributary rivers. The Dismal Swamp National Wildlife Refuge is located about 16 km (10 mi) from the two terminals on the Elizabeth River, but water drainage from the swamps is toward the port area. The swamp refuge is far enough from the terminals that potential negative impacts of low-probability, severe accidents in the ports on wildlife populations would be negligible. The three port terminals at Hampton Roads are described separately below.

Climatic Conditions: The geographic location of this region is especially favorable, tending to be located south of the predominant winter extratropical cyclone tracks which originate at higher latitudes and north of the usual tropical cyclone (e.g., tropical storms and hurricanes) paths. In general, the winters are mild with slightly warmer temperatures during the spring and fall seasons. The summer season is warm and long, but is characterized by frequent cool periods, generated by cool northeasterly winds off of the North Atlantic. Extreme cold waves are infrequent, and temperatures below -18°C (0°F) are almost nonexistent. In general, winters pass without measurable snowfall and most snowfall melts within 24 hours. The average first sub-freezing day in the fall is November 17th and the last occurrence in the spring is March 23rd. The predominant wind directions since 1984 are from the south-southwest and north-northeast and vary seasonally (NOAA, 1992c).

The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Hampton Roads, the Uniform Building Code provides a basic wind speed of about 140 km per hour (90 mph). The port is located in a low seismic zone with an acceleration of 0.075 g.

Newport News Marine Terminal: This terminal is located on the north shore of the Port of Hampton Roads on the James River. It is a combination container, roll-on/roll-off, and breakbulk terminal. The facility has two piers, two container vessel berths, and four container cranes. There is covered storage on both piers. A map of the Newport News Marine Terminal is shown in Figure 3-12.

The 1990 population within 16 km (10 mi) of the port terminal was 430,757. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 181,000; the Oak Ridge Reservation, 209,000; the Idaho National Engineering Laboratory, 628,000; the Hanford Site, 677,000; and the Nevada Test Site, 691,000. Populations along rail

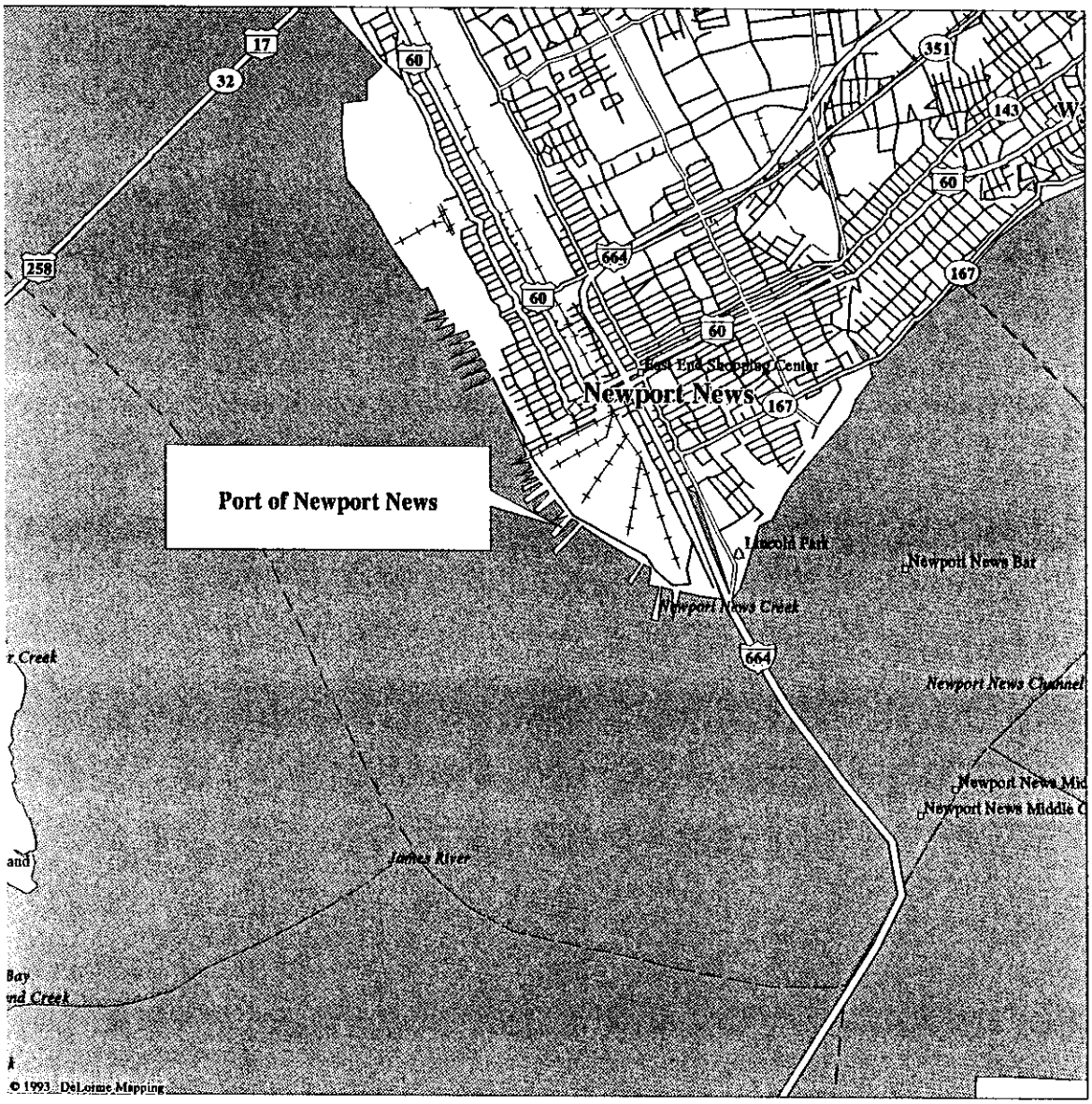

Figure 3-12 Port of Newport News, VA

routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 840 km (522 mi); the Oak Ridge Reservation, 890 km (553 mi); the Idaho National Engineering Laboratory, 4,010 km (2,492 mi); the Hanford Site, 4,680 km (2,908 mi); and the Nevada Test Site, 4,172 km (2,592 mi). Distances along rail routes are slightly longer.

Ethnic and Income Characteristics: Figure 3-13 shows the ethnic composition for the area surrounding the port at Newport News. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 32 percent of the total population, and approximately 86 percent of the minority population for the area surrounding the port. Figure 3-14 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

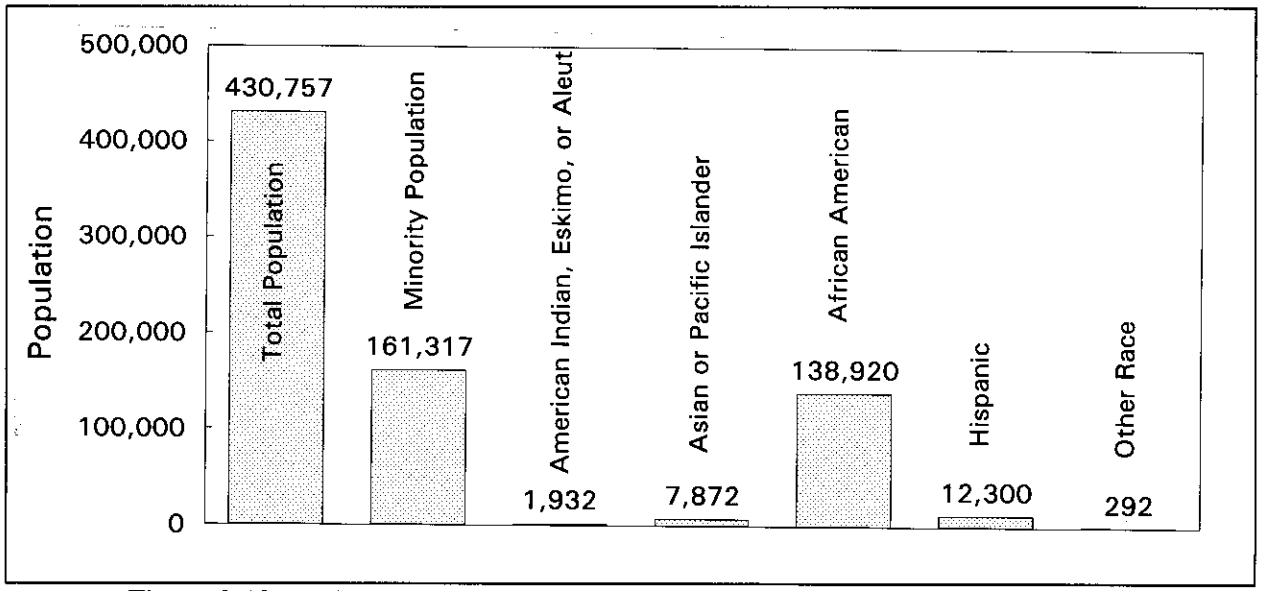

Figure 3-13 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Newport News

Norfolk International Terminal: This terminal is located on the south side of the Port in Norfolk, adjacent to the Navy Base on the Elizabeth River Channel. Norfolk International Terminal has 4 container vessel berths, 7 container cranes, a roll-on/roll-off berth, and covered pier storage. Sewell's Point Terminal, located at the north end (seaward) of Norfolk International Terminal's container berths has two piers, and covered storage for breakbulk cargoes. A map of Norfolk International Terminal is shown in Figure 3-15.

The 1990 population within 16 km (10 mi) of the port terminals was 681,864. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 131,000; the Oak Ridge Reservation, 174,000; the Idaho National Engineering Laboratory, 631,000; the Hanford Site, 694,000; and the Nevada Test Site, 694,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 800 km (497 mi); the Oak Ridge Reservation, 880 km (547 mi); the Idaho National Engineering Laboratory, 4,070 km (2,529 mi); the Hanford Site, 4,740 km (2,945 mi); and the Nevada Test Site, 4,240 km (2,635 mi). Distances along rail routes are slightly longer.

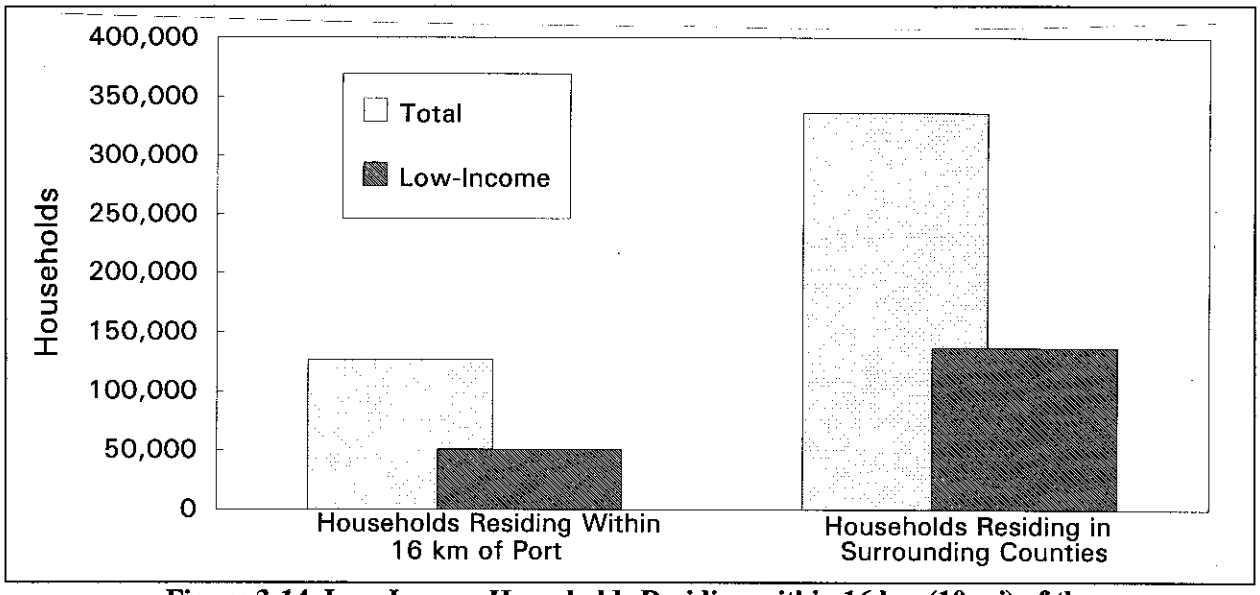

Figure 3-14 Low-Income Households Residing within 16 km (10 mi) of the Port of Newport News

Ethnic and Income Characteristics: Figure 3-16 shows the ethnic composition for the area surrounding the port at Norfolk, VA. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 33 percent of the total population, and approximately 93 percent of the minority population for the area surrounding the port. Figure 3-17 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

Portsmouth Marine Terminals: Portsmouth Marine Terminals are located at the confluence of the Elizabeth River and its western branch in the city of Portsmouth. The terminals have 3 berths that handle container, breakbulk and roll-on/roll-off cargoes. The terminals have 3 container cranes, and more than 14,000 m^2 (150,000 ft^2) of warehouse space. A map of the Portsmouth Marine Terminals is shown in Figure 3-18.

The 1990 population within 16 km (10 mi) of the Portsmouth Marine Terminals was 665,700. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 135,000; the Oak Ridge Reservation, 257,000; the Idaho National Engineering Laboratory, 670,000; the Hanford Site, 718,000; and the Nevada Test Site, 732,000. Populations along rail routes to these sites are about the same for eastern sites and slightly larger for western sites. The distances to the five potential sites on interstate routes are: the Savannah River Site, 810 km (503 mi); the Oak Ridge Reservation, 780 km (485 mi); the Idaho National Engineering Laboratory, 4,040 km (2,510 mi); the Hanford Site, 4,710 km (2,927 mi); and the Nevada Test Site, 4,210 km (2,616 mi). Distances along rail routes are slightly longer.

Ethnic and Income Characteristics: Figure 3-19 shows the ethnic composition for the area surrounding the port at Portsmouth. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 33 percent of the total population, and approximately 89 percent of the minority population for the area surrounding the port. Figure 3-20 shows analogous information for

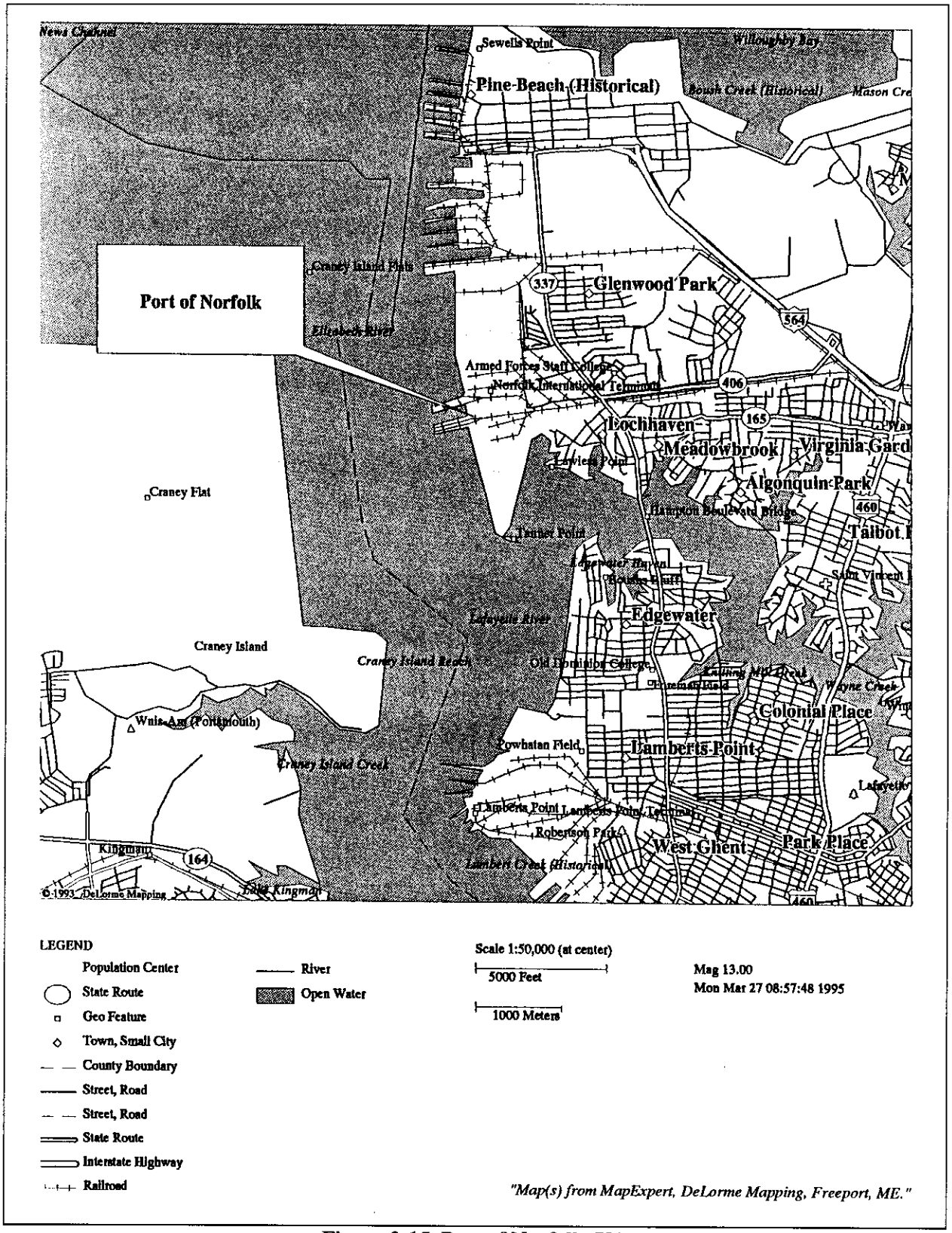

Figure 3-15 Port of Norfolk, VA

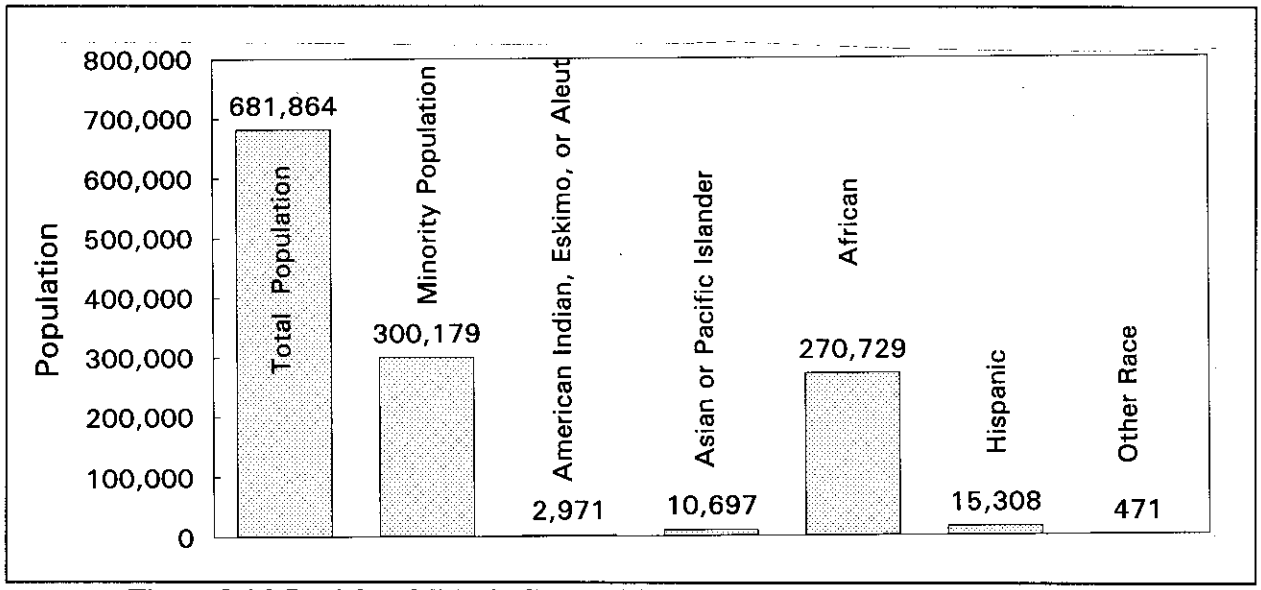

Figure 3-16 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Norfolk

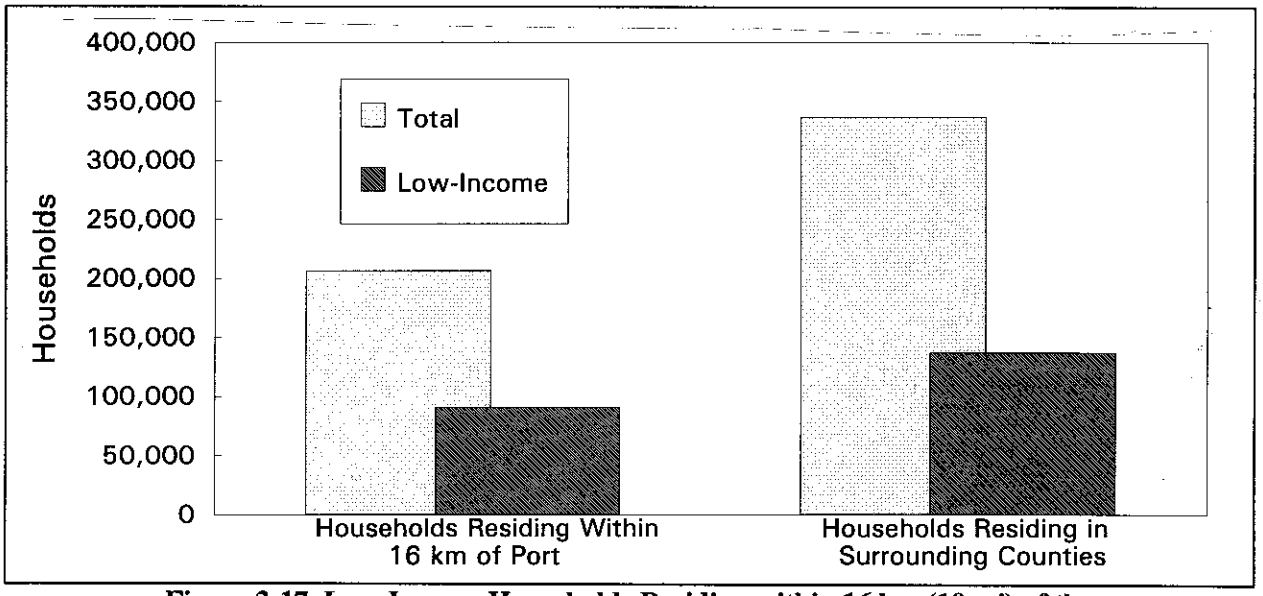

Figure 3-17 Low-Income Households Residing within 16 km (10 mi) of the Port of Norfolk

low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.4 Jacksonville, FL

The Port of Jacksonville is located on the Atlantic Coast of northern Florida, along the St. Johns River. It is a geographically large city (1,967 km^2 or 760 mi^2) ranging from the town of Orange on the east side of the river to Julington Creek on the west side. Most of the marine terminals are on the west side of the river, about 34 km (21 mi) from the ocean entrance. However, the Blount Island container terminal is well

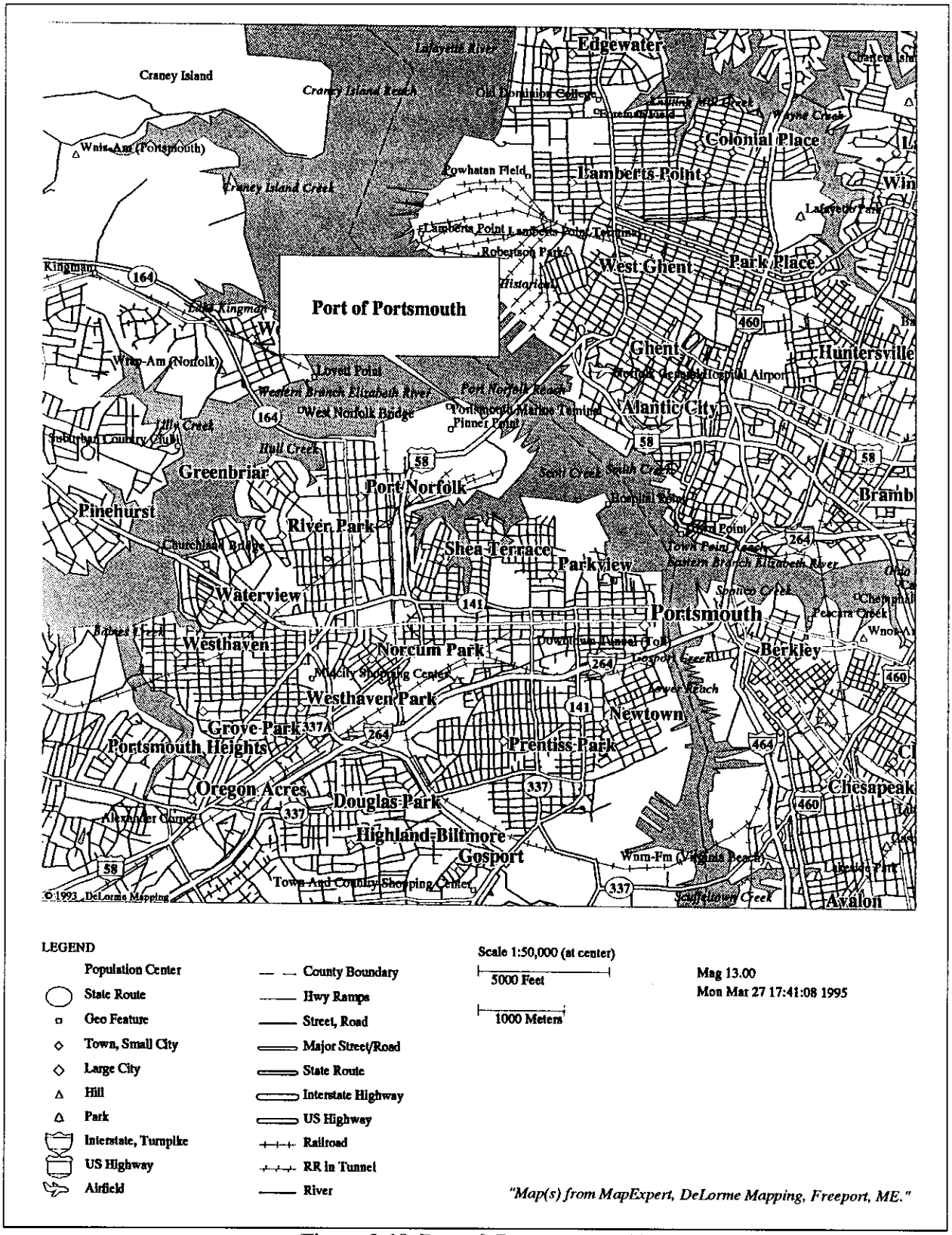

Figure 3-18 Port of Portsmouth, VA

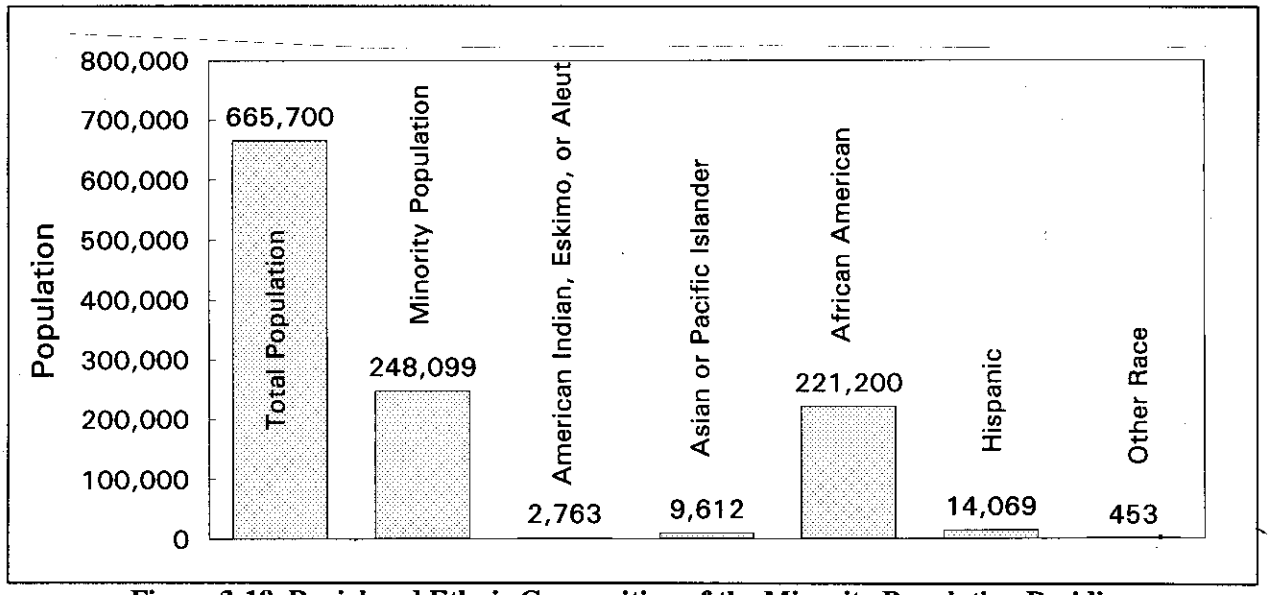

Figure 3-19 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Portsmouth

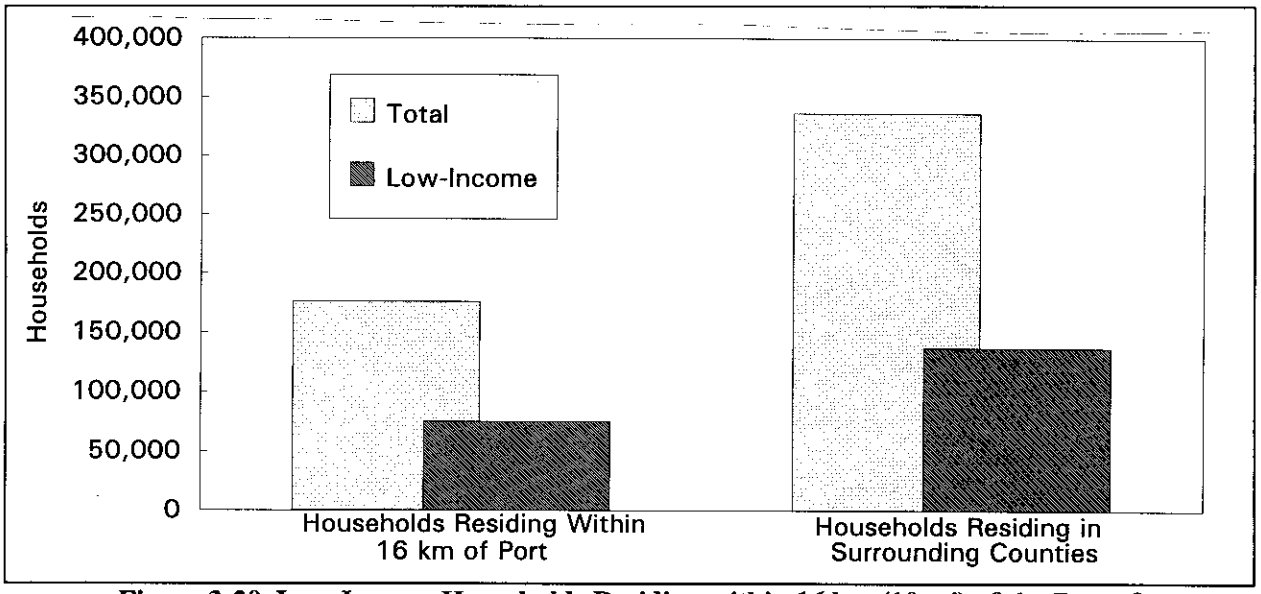

Figure 3-20 Low-Income Households Residing within 16 km (10 mi) of the Port of Portsmouth

separated from the city, and is only about 11 km (7 mi) from the harbor entrance. A map of the port is shown in Figure 3-21. A Federal project maintains a channel depth of 12.2 m (40 ft) to 12.8 m (42 ft) at the entrance to the river.

The St. Johns River has a deep, steep-sided channel cut through rock in some areas. Tidal currents are strong in the river as far as Jacksonville, approaching 3 knots in several places.

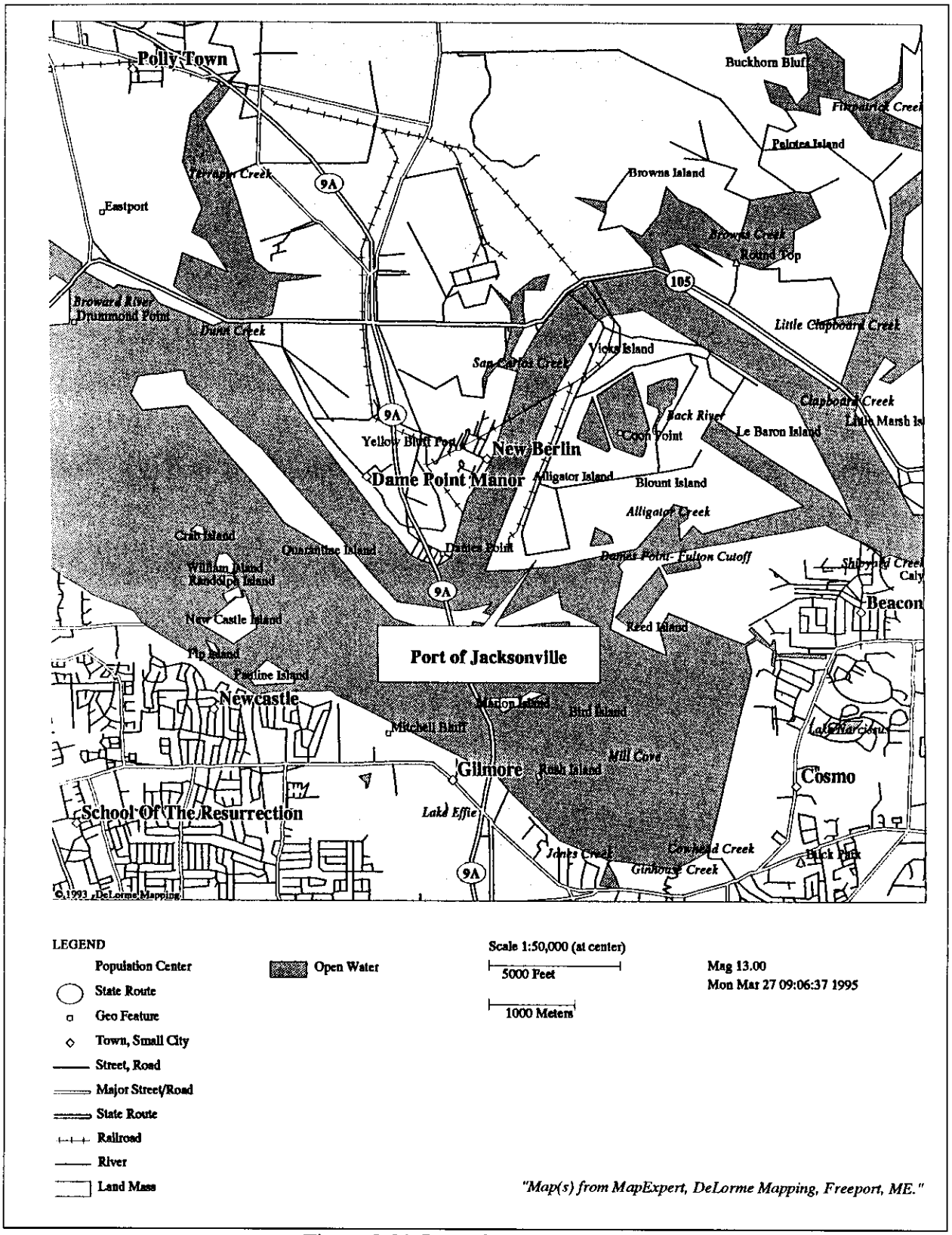

Figure 3-21 Port of Jacksonville, FL

There are two deepwater container/general cargo terminals: Blount Island, located approximately 11 km (7 mi) from the harbor entrance, and Talleyrand Docks and Terminals located about 34 km (21 mi) from the entrance. Both terminals are equipped with modern cranes, handle breakbulk and other types of cargo, and have warehouse as well as open storage areas. Of the two, Blount Island would be preferred because of its separation from the high-density downtown area and closer proximity to the sea.

Blount Island Terminal: Blount Island is a 356 ha (880 acre) facility with 1,920 m (6,336 ft) of berthing space. Blount Island berths 7-13 have 11.6 m (38 ft) of water alongside at mean low water, and five container cranes. This terminal is connected to the mainland via a fixed highway bridge which joins State Highway 105 (Necksher Drive) and connects with I-95 and Route 17 about five miles north of the city of Jacksonville. Blount Island has pierside service by the CSX Railroad, which connects with the Norfolk Southern Railroad.

Talleyrand Terminal: Talleyrand Docks is a 70 ha (173 acre) facility with 1,250 m (4,100 ft) of wharf on deep water (11.6 m or 38 ft at mean low water). It has two container cranes and two large gantry cranes. Talleyrand Terminal is located in downtown Jacksonville's shopping and commercial zone, about 2.9 km (1.8 mi) downstream of the John R. Matthews Bridge (alternate U.S. Route 90), and less than 1.0 km (0.6 mi) via city streets from the city Expressway system.

The 1990 population within 16 km (10 mi) of the port terminals was 334,212. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 46,900; the Oak Ridge Reservation, 175,000; the Idaho National Engineering Laboratory, 576,000; the Hanford Site, 643,000; and the Nevada Test Site, 639,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 607 km (377 mi); the Oak Ridge Reservation, 912 km (567 mi); the Idaho National Engineering Laboratory, 4,030 km (2,504 mi); the Hanford Site, 4,700 km (2,920 mi); and the Nevada Test Site, 4,190 km (2,604 mi). Distances along rail routes are about the same.

Environmental Conditions: The area between the mouth of the St. Johns River and Blount Island is characteristic of typical coastal lowlands found along the southeastern United States. Numerous creeks meander through large expanses of marshes and swamps. With the exception of the U.S. Naval Station Mayport and the village of Mayport, which occupy the first several miles along the southern bank of the river, the land bordering the lower portion of the river is largely undeveloped with the exception of riverfront residences, mainly along the northern bank. Most of the land to the north of the river between Blount Island and the coast is part of the Nassau River - St. Johns River Marshes Aquatic Preserve. The Fort Caroline National Memorial is located southeast of Blount Island on the southern bank of the river. The Little Talbot Island State Park is located approximately 1.6 km (1 mi) north of the channel entrance.

The lower 24.2 km (15 mi) of the St. Johns River has been designated as critical habitat for the manatee, a listed endangered species. The river is also used as a migratory area for the shortnose sturgeon, a listed endangered species (FWS, 1980b). According to the Florida Natural Areas Inventory, the following rare species have been reported within 3.2 km (2 mi) of the Blount Island Terminal: West Indian manatee (State and Federally Listed Endangered Species), shortnose sturgeon (State and Federally Listed Endangered Species), Atlantic sturgeon (State-Listed Species of Special Concern and Federally Listed Threatened Species), sea lamprey, and the opossum pipefish (Murray, 1994).

A variety of wading birds is also found in the vicinity of the Fort Caroline National Memorial. Several species of birds, including shorebirds, waterfowl, and gannets frequent the area around the jetties at the channel entrance. In particular, the brown pelican, a State Species of Special Concern, is found in this

area. A variety of birds inhabits the Little Talbot Island State Park, including the American oystercatcher, a State Species of Special Concern. Loggerhead sea turtles, a listed endangered species, use the beaches along this portion of Florida as a nesting area (FWS, 1980b).

While environmental awareness is high throughout the state of Florida, there are no known sensitive wildlife sanctuaries in the immediate area of the Port of Jacksonville. Blount Island is surrounded by extensive marsh and wetlands.

Climatic Conditions: The Port of Jacksonville is located along the upper 39.4 km (24.5 mi) of the St. Johns River. The terrain in this area is relatively level, providing very little change in relief proceeding inland from the coastal region. The National Weather Service has been archiving meteorological information for this area since 1880.

The climate of this area is modified by the influence of the Atlantic Ocean. Easterly winds occur roughly 40 percent of the time, producing a true maritime climate for the Jacksonville area. The greatest rainfall occurs during summer, usually associated with afternoon and evening thunderstorms. During summer, measurable precipitation can be recorded nearly every two days. The prevailing winds are northeasterly in the fall and winter months, becoming more southwesterly during spring and summer. Although Jacksonville is along the eastern U.S. coast, it has been very fortunate in escaping hurricane-force winds. The majority of systems in recent years which have reached this latitude have moved parallel to the coastline, keeping well offshore. Others have weakened significantly moving overland prior to reaching metropolitan Jacksonville. The combination of these two factors has spared the area from any major devastation due to tropical systems in recent years (NOAA, 1992b). The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Jacksonville, the Uniform Building Code provides a basic wind speed of about 160 km per hour (100 mph). The port is located in a very low seismic zone with an acceleration of less than 0.075 g.

Ethnic and Income Characteristics: Figure 3-22 shows the ethnic composition for the area surrounding the port at Jacksonville. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans were the largest minority group. Figure 3-23 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.5 Military Ocean Terminal Sunny Point, NC

The Military Ocean Terminal at Sunny Point (MOTSU) is a U.S. Department of Defense transportation facility located north of Southport, NC. The facility is located on the Cape Fear River, approximately 16 km (10 mi) upstream (north) from the mouth of the river, and 26 km (16.1 mi) south of the Port of Wilmington, NC. A map of MOTSU is shown in Figure 3-24. The port is easily accessed from the ocean, and all commercial vessels bound for Wilmington, NC must pass by MOTSU. It is served by a 12.1 m- (40 ft-) deep by 152 m- (500 ft-) wide channel from the ocean.

The water depth (channel and alongside the wharves) of 10.3 m (34 ft) at mean low water is adequate for most commercial breakbulk, roll-on/roll-off, and container ships. The terminal has three 600 m (2,000 ft) wharves, each with three berths. All wharves have three parallel sets of rail tracks. Berth 1, on the south

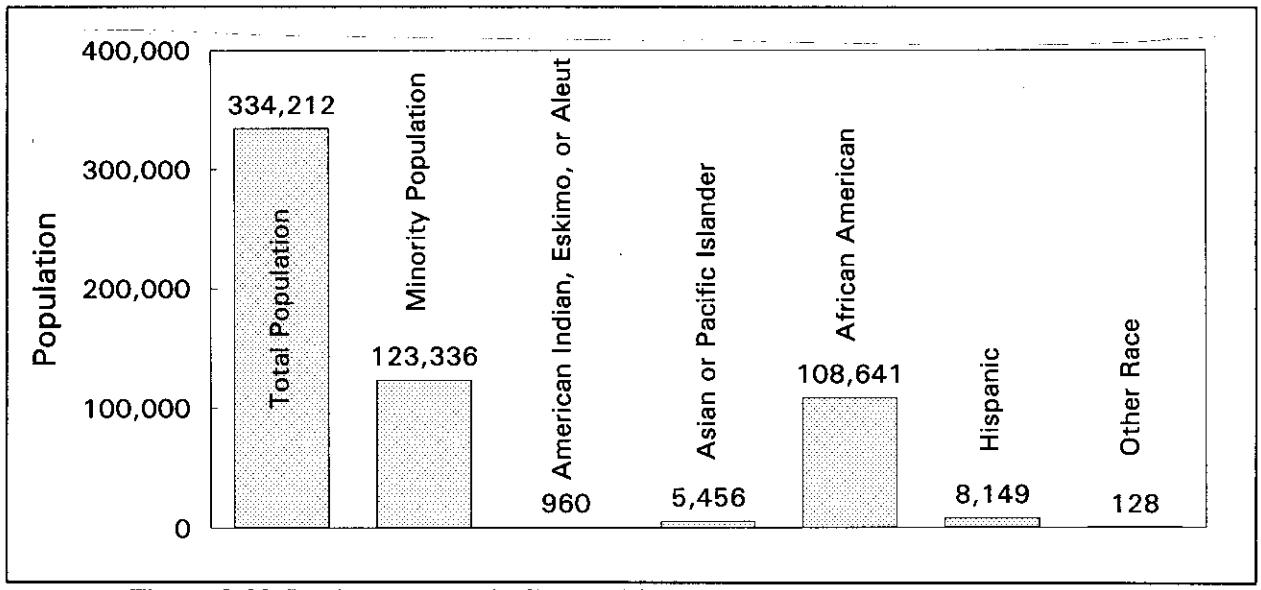

Figure 3-22 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Jacksonville

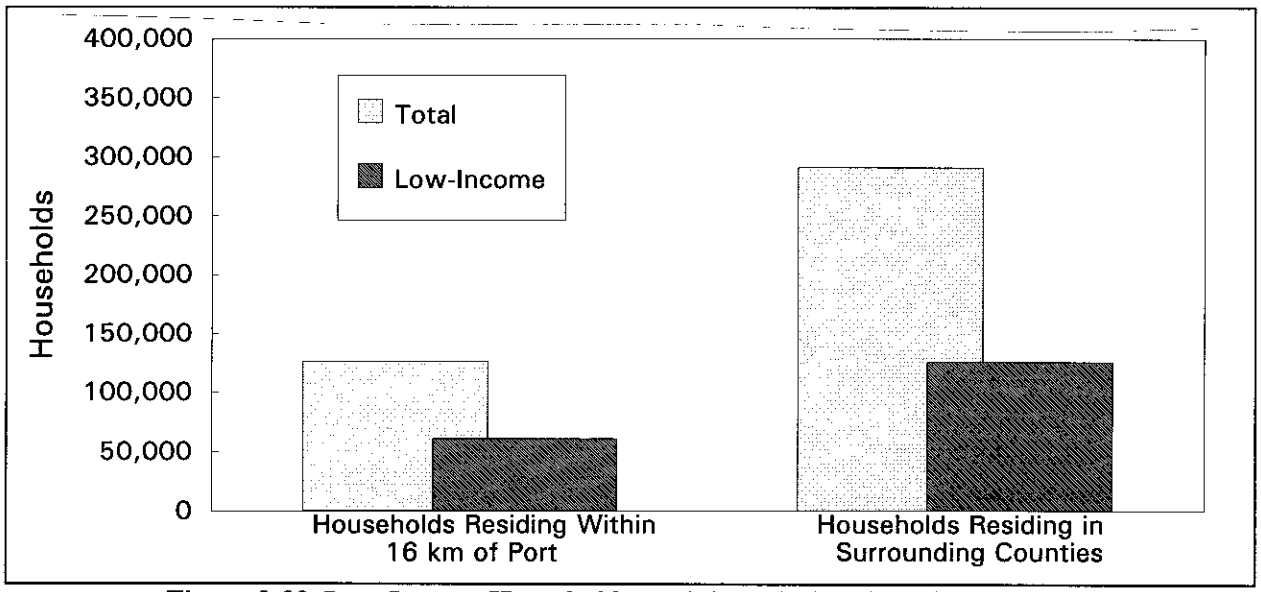

Figure 3-23 Low-Income Households Residing within 16 km (10 mi) of the Port of Jacksonville

wharf, has two 50 metric ton (55 ton) container cranes capable of off-loading container or container/breakbulk vessels. Berth 3 has been modified with a 30 m (100 ft) wide, reinforced concrete apron that permits breakbulk and roll-on/roll-off operations, in addition to containerized cargoes.

MOTSU is serviced by well-maintained roads, and has a dedicated 157 km (98 mi) U.S. Army rail line that connects the CSX network directly to the terminal. Truck access is provided by State Route 87 from the northwest and State Route 133 from the north. Route 87 provides access to U.S. 17, which runs southwest or northeast. The distance from the terminal gate to Route 133 is about 3.7 km (2.2 mi). Route 133 runs directly to U.S. 17 just outside Wilmington. From Wilmington, U.S. 74 runs west 120 km (75 mi) to Interstate 95, the nearest major north-south highway.

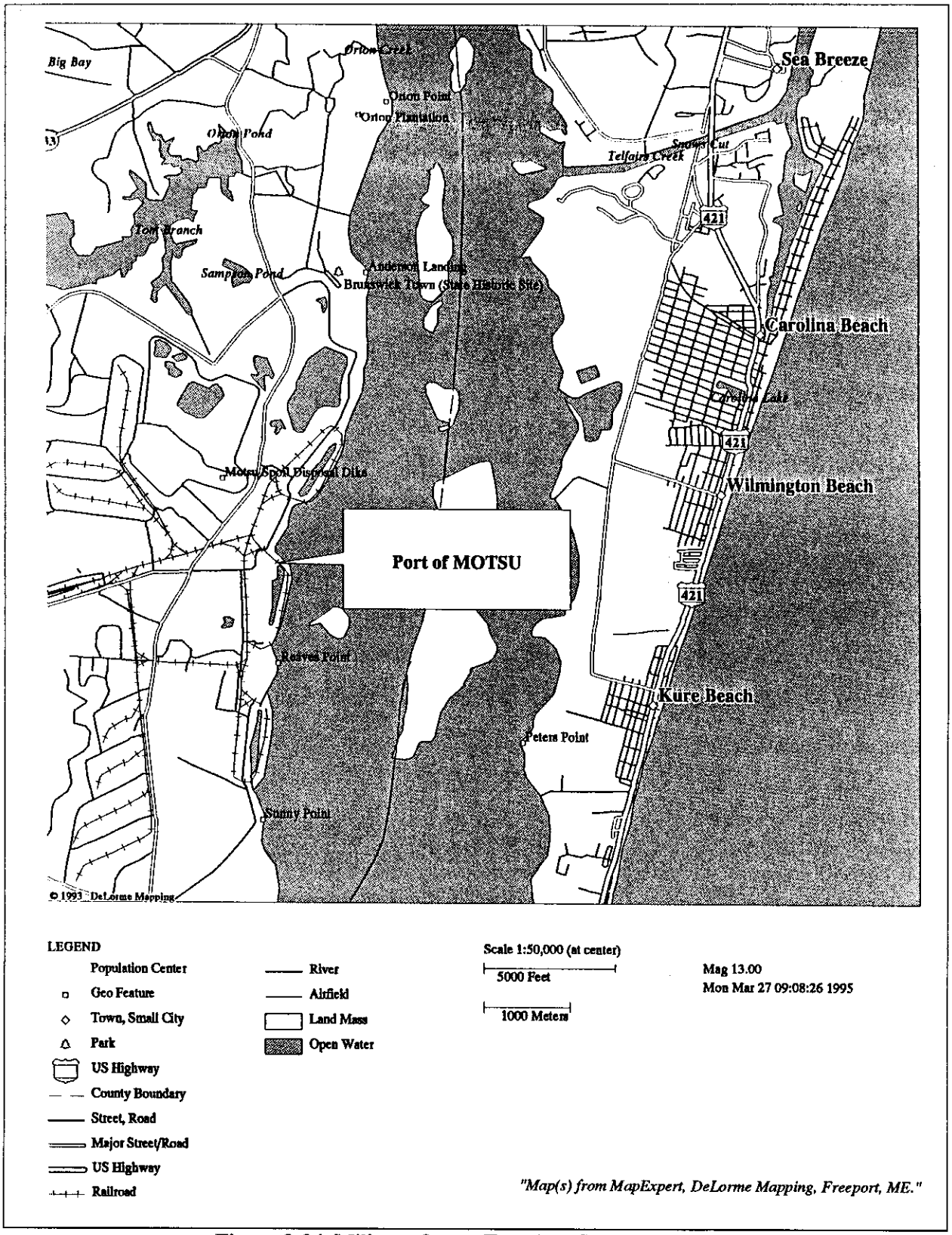

Figure 3-24 Military Ocean Terminal Sunny Point, NC

The 1990 population within 16 km (10 mi) of the port terminals was 7,995. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 34,200; the Oak Ridge Reservation, 128,000; the Idaho National Engineering Laboratory, 463,000; the Hanford Site, 548,000; and the Nevada Test Site, 619,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 402 km (250 mi); the Oak Ridge Reservation, 798 km (496 mi); the Idaho National Engineering Laboratory, 3,873 km (2,407 mi); the Hanford Site, 4,615 km (2,868 mi); and the Nevada Test Site, 3,953 km (2,456 mi). Distances along rail routes are slightly longer.

Environmental Conditions: The environmental conditions at MOTSU are similar to those at the Port of Wilmington, NC, and are described in Section 3.2.1.10. MOTSU has been identified as an area with sinkhole activities (Koch, 1984). Sinkholes can occur naturally or as a result of human activity. Occurrences of sinkholes are closely tied to the drainage pattern in areas where geologic formations provide a collapse mechanism. Human activities which modify the natural drainage pattern in such an area can increase the rate of sinkhole formation. Sinkholes pose a potential hazard to truck and rail traffic in the Sunny Point area. Due to the robust casks which would be used to transport spent nuclear fuel from foreign research reactors (see Appendix B for a description of the casks), sinkholes would not be expected to cause a radiological accident.

Climatic Conditions: The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. For MOTSU, the Uniform Building Code provides a basic wind speed of about 160 km per hour (100 mph) (UBC, 1991). The port is located in a low seismic zone with an acceleration of 0.075 g.

Other climatic conditions at MOTSU are similar to those at the Port of Wilmington, NC, and are described in Section 3.2.1.10.

Ethnic and Income Characteristics: Figure 3-25 shows the ethnic composition for the area surrounding MOTSU. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 17 percent of the total population, and approximately 91 percent of the minority population for the area surrounding the port. Figure 3-26 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.6 Naval Weapons Station, Concord, CA

Naval Weapons Station (NWS) Concord is located on the southern edge of Suison Bay, an estuarine area immediately west of the junction of the Sacramento and San Joaquin Rivers. By water, the NWS is approximately 58 km (36 mi) northeast of the Golden Gate Bridge. The city of Concord, CA, is about 8 km (5 mi) south of the NWS. A map of the NWS military port is shown in Figure 3-27.

The 1990 population within 16 km (10 mi) of the port terminal was 381,070. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 1,040,000; the Oak Ridge Reservation, 742,000; the Idaho National Engineering Laboratory, 271,000; the Hanford Site, 263,000; and the Nevada Test Site, 437,000. Populations along rail routes to these sites are slightly smaller for the Oak Ridge Reservation, the Idaho National Engineering Laboratory and the Nevada Test Site, and slightly larger for the Savannah River Site and the Hanford Site. The distances to the five potential sites on interstate routes are: the Savannah River Site, 4,476 km (2,781 mi); the Oak Ridge Reservation, 4,111 km (2,554 mi); the Idaho National Engineering Laboratory,

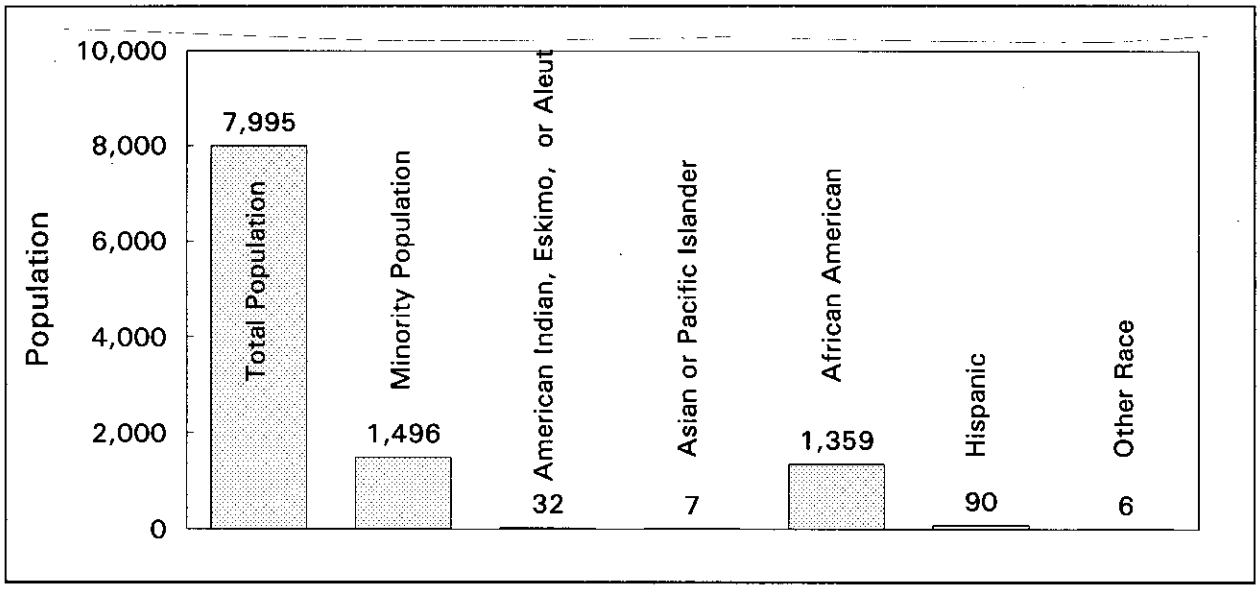

Figure 3-25 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of MOTSU

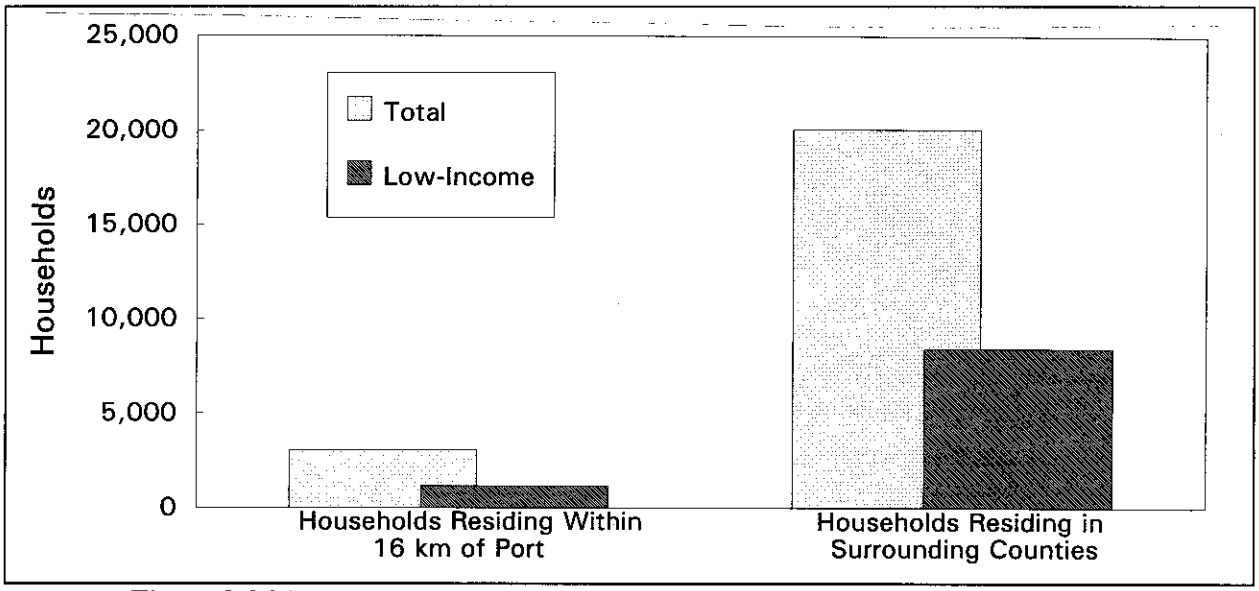

Figure 3-26 Low-Income Households Residing within 16 km (10 mi) of MOTSU

1,516 km (942 mi); the Hanford Site, 1,376 km (855 mi); and the Nevada Test Site, 1,145 km (711 mi). Distances along rail routes are about the same for the Idaho National Engineering Laboratory, and slightly longer for the Savannah River Site, the Oak Ridge Reservation, the Hanford Site, and the Nevada Test Site.

Environmental Conditions: NWS Concord occupies 5,233 ha (12,931 acres) of land adjoining south Suison Bay. Of this total acreage, 2,135 ha (5,276 acres) are inland, while 3,097 ha (7,653 acres) are more tidal in nature. Wetlands comprise approximately 1,215 ha (3,002 acres) of the tidal area (Yocum, 1994). Wetlands occupy large areas of land bordering all sides of Suison Bay and Grizzly Bay, which is located

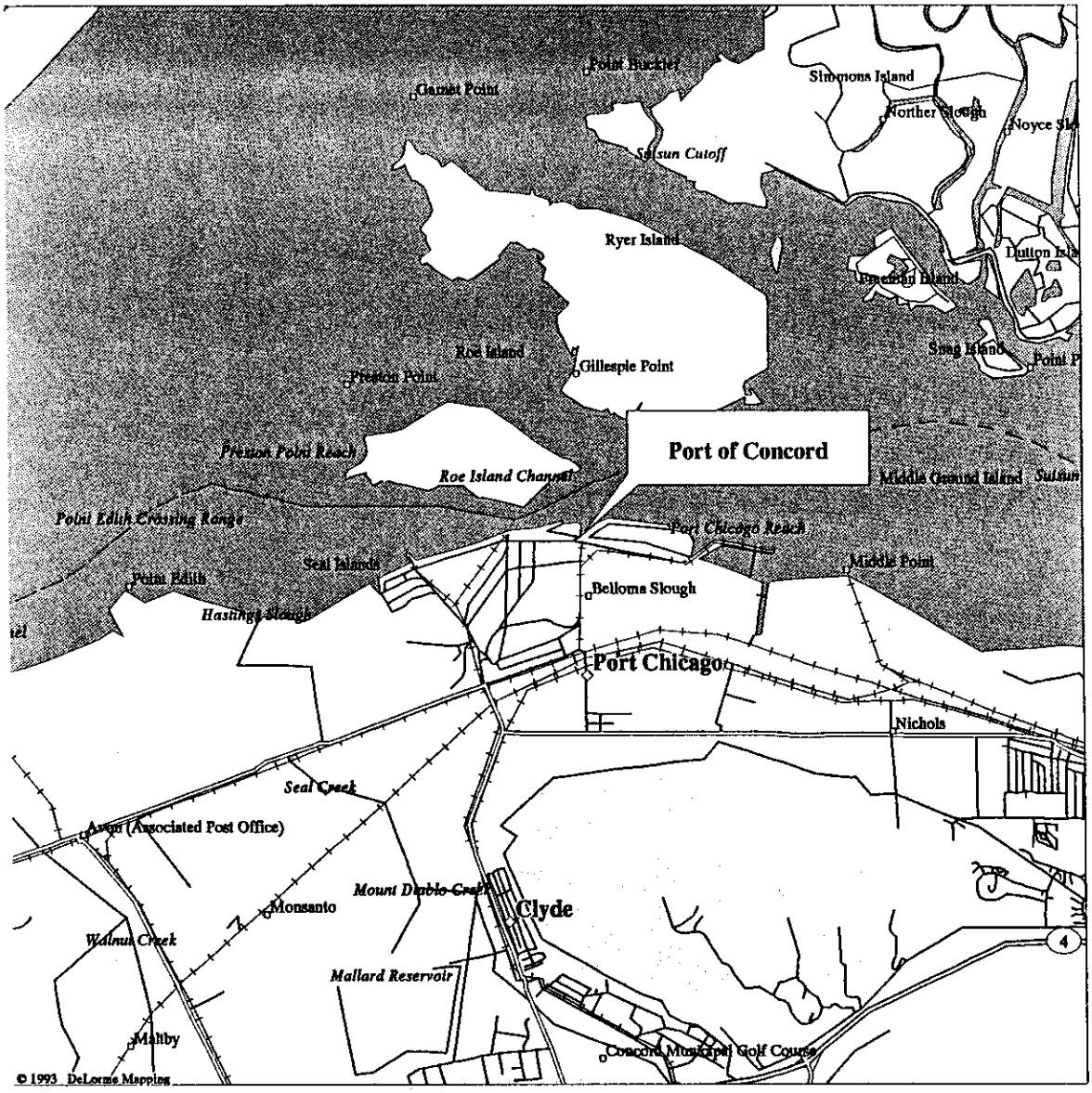

Figure 3-27 Naval Weapons Station Concord, CA

directly north of Suison Bay. The waters of Suison Bay are characterized as a mid-salinity estuarine habitat (generally 5 to 16.5 ppt). Chinook salmon, steelhead trout, striped bass, sturgeon, and American shad are typically found in this area (FWS, 1981a; FWS, 1981b).

Portions of the inland area at NWS Concord serve as a sanctuary for Tule elk, a formerly endangered species (Yocum, 1994). Other terrestrial species found in the area include the river otter, the salt-marsh harvest mouse (a Federally protected species), and the white-tailed kite. Adult concentrations and nesting areas of the California clapper rail (a Federally protected bird species) and the California black rail (a State protected species) are also found in this area. The Federally and State protected figwort plant family is also found in the vicinity of NWS Concord. In general, the greater San Francisco Bay area annually supports large numbers of shorebirds, wintering waterfowl, raptors, seabirds, and passerlings. In addition, shorebirds, wading birds, waterfowl, seabirds, and songbirds migrate through this coastal area.

Climatic Conditions: The climate is mild, with plenty of sunshine year round. Cloudless skies prevail during the spring, summer, and fall. Winter is the rainy season. Snow is rare, as are freezing temperatures. Sometimes torrential rains on the slopes can cause flooding along the Sacramento River (NOAA, 1993b).

The likelihood of severe natural phenomena, such as high winds and earthquakes, is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Concord NWS, the Uniform Building Code provides a basic wind speed of about 110 km per hour (70 mi per hour). The port is located on the edge of a very high seismic zone with an acceleration of 0.45 g.

Ethnic and Income Characteristics: Figure 3-28 shows the ethnic composition for the area surrounding NWS Concord. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 7 percent of the total population, and approximately 24 percent of the minority population for the area surrounding the port. Other minorities include Asian or Pacific Islanders (11 percent of total population), and Hispanics (10 percent of total population). These groups constitute 38 percent and 35 percent of the minority population, respectively. Figure 3-29 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.7 Portland, OR

The Port of Portland is located about 160 km (100 mi) above the mouth of the Columbia River on the Willamette River tributary. Portland is the principal city of the Columbia River system, and one of the major ports on the Pacific Coast. The container terminal that would be used for potential receipt of foreign research reactor spent nuclear fuel is located approximately 170 km (106 mi) from the entrance of the Columbia River. Federal project depths in the Columbia River are 14.6 m (48 ft) at the mouth of the river, and 12 m (40 ft) at Portland. A map of the port is shown in Figure 3-30.

The 1990 census population within 16 km (10 mi) of the port was 356,064. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 686,000; the Oak Ridge Reservation, 519,000; the Idaho National Engineering Laboratory, 143,000; the Hanford Site, 85,700; and the Nevada Test Site, 375,000. Populations along rail routes to these sites are slightly smaller for the Nevada Test Site and the Idaho National Engineering Laboratory, but slightly larger for the Savannah River Site, the Oak Ridge Reservation, and the Hanford

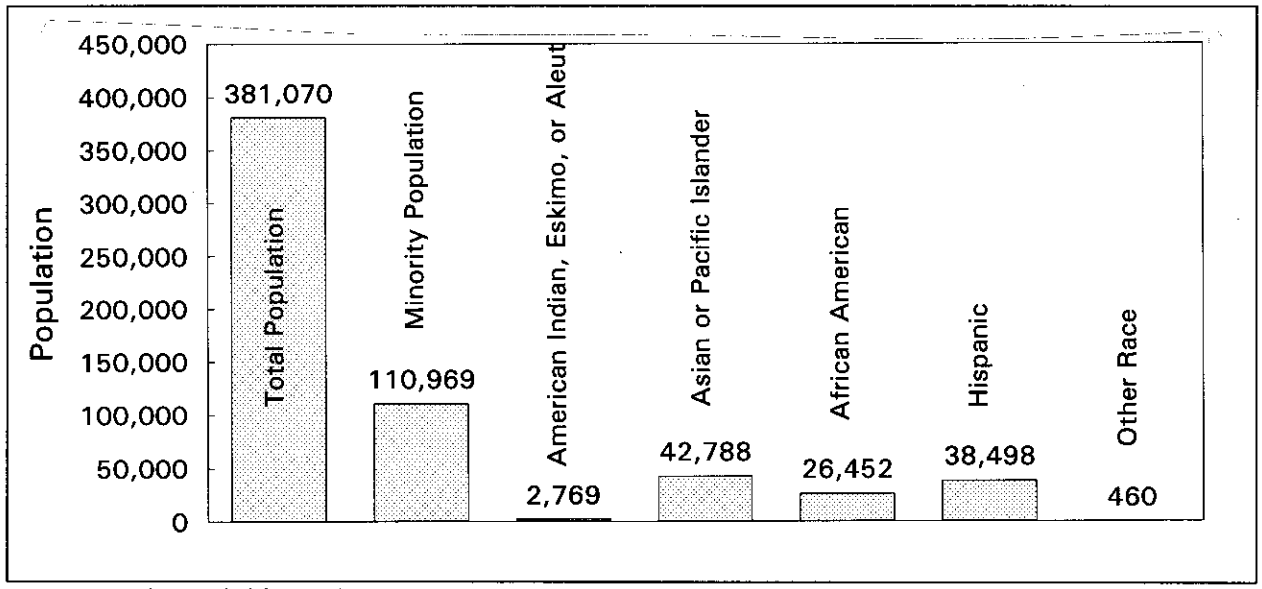

Figure 3-28 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of NWS Concord

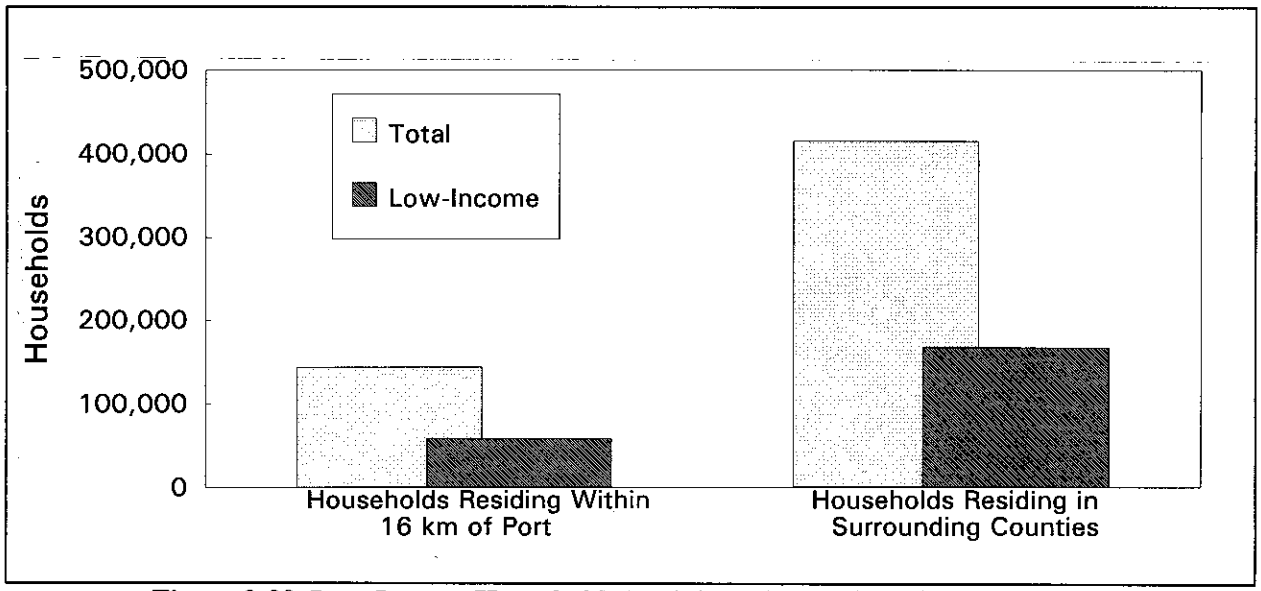

Figure 3-29 Low-Income Households Residing within 16 km (10 mi) of NWS Concord

Site. The distances to the five potential sites on interstate routes are: the Savannah River Site, 4,630 km (2,877 mi); the Oak Ridge Reservation, 4,200 km (2,610 mi); the Idaho National Engineering Laboratory, 1,190 km (739 mi); the Hanford Site, 407 km (253 mi); and the Nevada Test Site, 2,040 km (1,268 mi). Distances along rail routes are slightly longer, with the exception of the Hanford Site, which is slightly shorter.

Environmental Conditions: There are no known areas of special environmental concern in the immediate vicinity of the port, although concern for the environment runs high throughout the Pacific Northwest. The areas surrounding the Terminal are in river-oriented industrial land use. Wildlife habitat along the

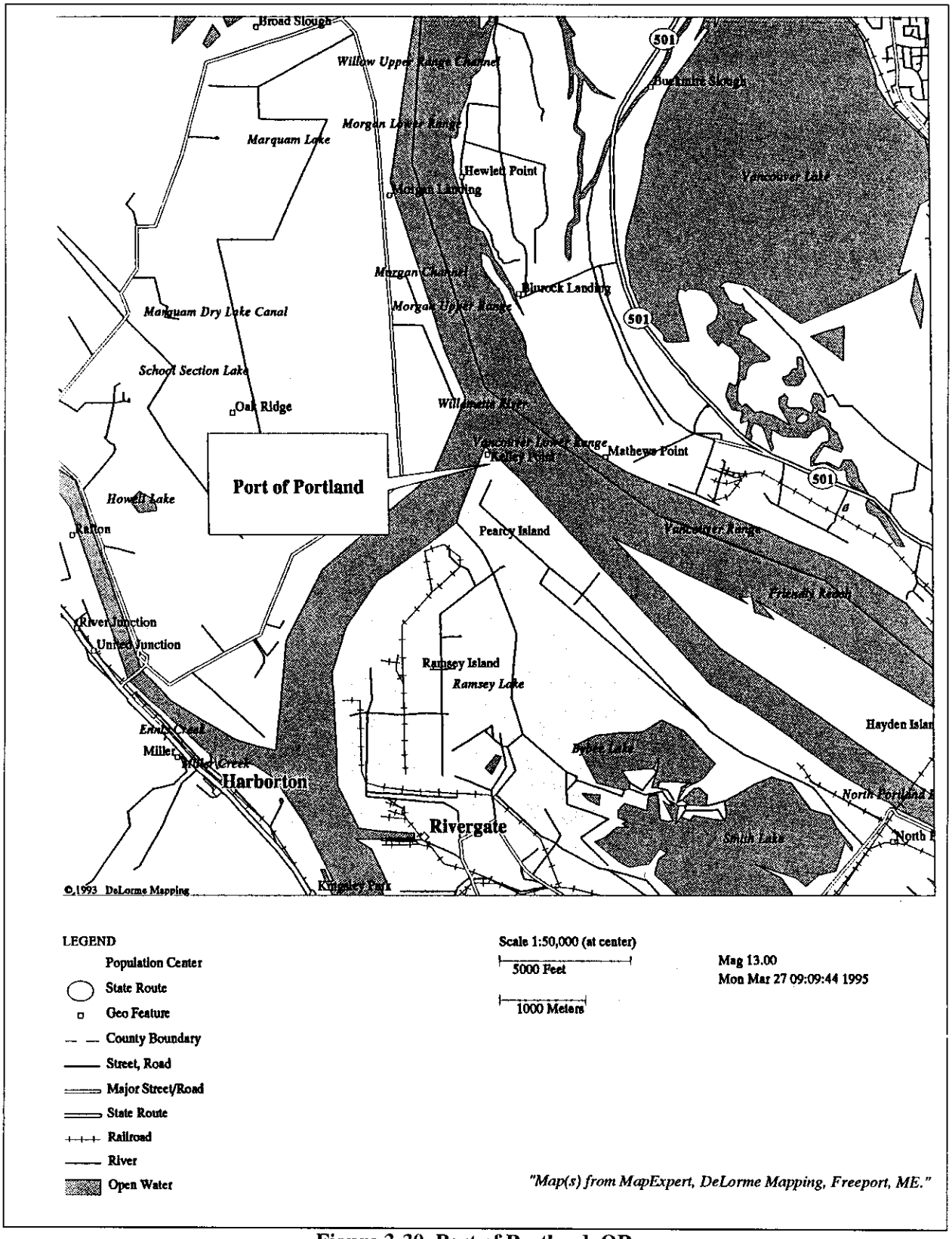

Figure 3-30 Port of Portland, OR

Oregon Slough is limited because of the industrial development, although some waterfowl use the area. While the primary uses in the Terminal area are commercial navigation and industry, some recreational fishing and boating occurs in Oregon Slough and the Columbia River.

The U.S. Fish and Wildlife Service's Ecological Inventory for the Vancouver, Washington-Oregon area indicates that the Columbia River generally includes the following fish species: salmonids, chinook salmon, coho salmon, chum salmon, pink salmon, sockeye salmon, steelhead trout, Dolly Varden, smelts, river lamprey, white sturgeon, American shad, eulachon and cutthroat trout (FWS, 1981c). South of Portland, the various islands and wetlands along the Columbia River provide habitat for a wide variety of terrestrial organisms. Areas of special interest include the Sauvie Island Game Management Area, which is located approximately 8 km (5 mi) downriver of Terminal 6, and the Ridgefield National Wildlife Refuge, which is approximately 16 km (10 mi) downriver.

The U.S. Army Corps of Engineers reports that raptors such as the red-tail hawk, bald eagle, and peregrine falcon are occasional visitors to this area and the U.S. Fish and Wildlife Service has indicated that the endangered American peregrine falcon and threatened bald eagle may winter in this area. In addition, the National Marine Fisheries Service has listed the Snake River sockeye salmon as endangered, and two Snake River chinooks stocks as threatened (Kurkoski, 1994). The State of Oregon's Natural Heritage Program reports that there are at least two rare species that occur in the vicinity of Terminal No. 6 (Gaines, 1994). These species are the painted turtle (a State-Sensitive-Critical species) and the Columbia water-meal.

Climatic Conditions: The port area is subject to earthquakes and volcanism (NOAA, 1992d). The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. For the Port of Portland, the Uniform Building Code provides a basic wind speed of about 140 km per hour (90 mph) (UBC, 1991). The port is located in a moderate seismic zone with an acceleration of 0.20 g. There have been two major earthquakes in the Puget Sound area this century (Bolt, 1978). On May 18, 1980, nearby Mount St. Helens suffered a major volcanic eruption. All the mountains along the Cascade Range are volcanic in origin and have some potential for eruption.

Ethnic and Income Characteristics: Figure 3-31 shows the ethnic composition for the area surrounding the port at Portland. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 8 percent of the total population, and approximately 50 percent of the minority population for the area surrounding the port. Hispanics and Asian or Pacific Islanders each accounted for about 20 percent of the minority population. Figure 3-32 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.8 Savannah, GA

The Port of Savannah is located on the south bank of the Savannah River, about 35 km (22 mi) above the entrance from the Atlantic Ocean. Savannah is the third largest city in Georgia, and is the chief port of the State of Georgia. The Savannah River serves as the boundary between Georgia and South Carolina. There are three large cargo terminals at the port. One of these terminals, Containerport, is a dedicated container handling terminal. It is located about 45.6 km (28.3 mi) up the Savannah River from the Atlantic Ocean. A map of the port is shown in Figure 3-33.

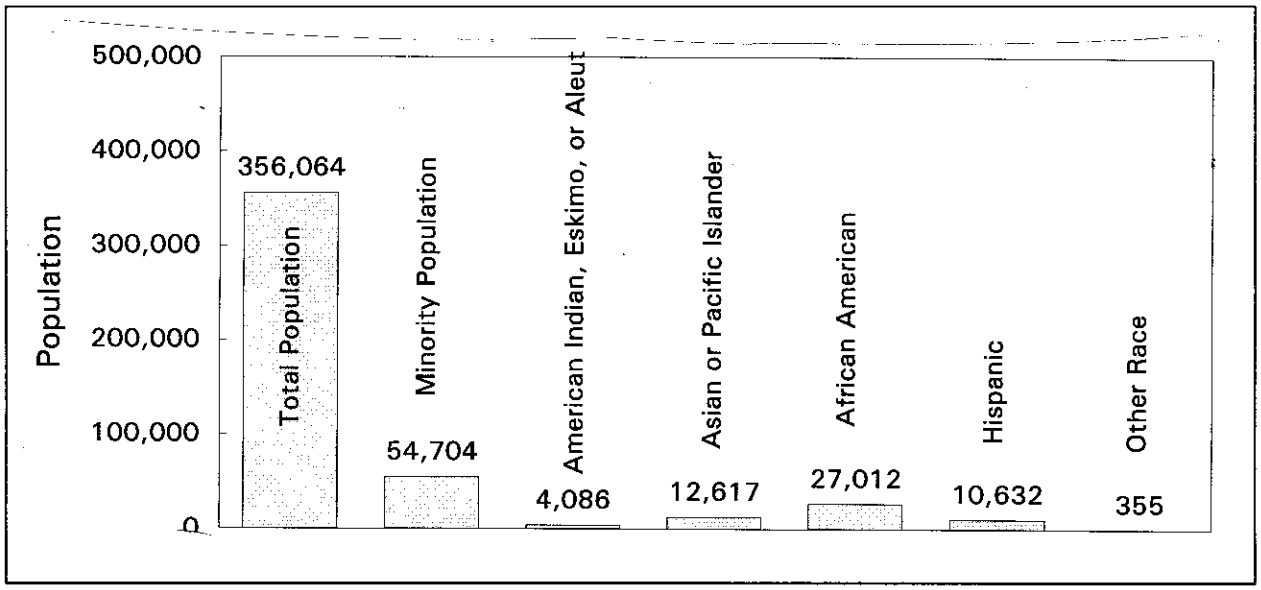

Figure 3-31 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Portland

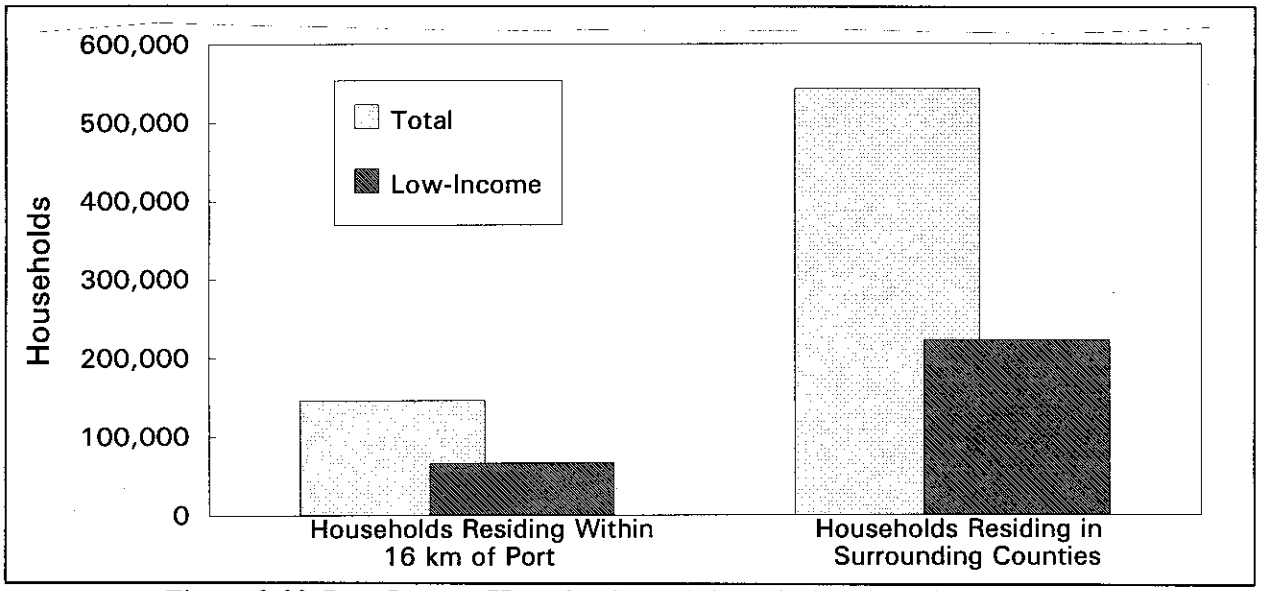

Figure 3-32 Low-Income Households Residing within 16 km (10 mi) of the Port of Portland

The 1990 population within 16 km (10 mi) of the port terminals was 155,166. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 37,300; the Oak Ridge Reservation, 101,000; the Idaho National Engineering Laboratory, 553,000; the Hanford Site, 602,000; and the Nevada Test Site, 616,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 400 km (249 mi); the Oak Ridge Reservation, 720 km (447 mi); the Idaho National Engineering Laboratory, 3,860 km (2,398 mi); the Hanford Site, 4,530 km (2,815 mi); and the Nevada Test Site, 4,020 km (2,498 mi). Distances along rail routes are slightly longer.

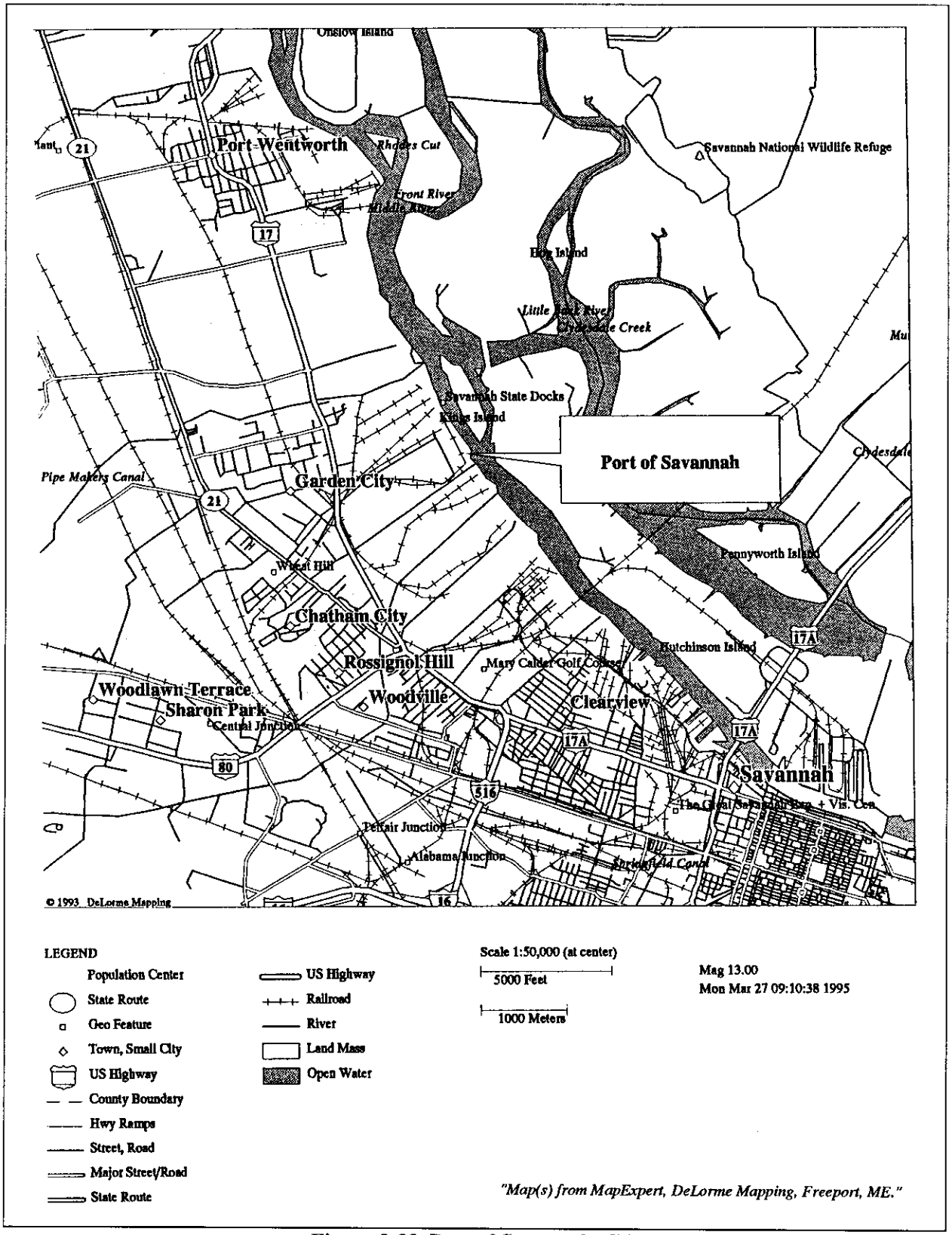

Figure 3-33 Port of Savannah, GA

Environmental Conditions: The lower Savannah River has multiple branches that meander through a variety of coastal lowlands including salt marshes, tidal creeks, freshwater marshes, and freshwater impoundments. South Carolina has classified its portion of the Savannah harbor upstream from Fort Pulaski (located at the mouth of the Savannah River) as Class B, and the portion oceanward as Class SA. Class B waters are freshwaters suitable for secondary contact recreation, use as a drinking water source following conventional treatment, fishing, industrial, and agricultural use. Class SA waters are defined as tidal salt waters suitable for primary contact recreation, and for all the uses listed in Class B. The State of Georgia has classified the Savannah River from mile 0 at Fort Pulaski north to mile 5 at Field's Cut as recreation waters. North of Field's Cut, the waters are classified as Coastal Fishing (U.S. Army, 1991). The river in the vicinity of Containerport is characterized as a transitional estuarine habitat, where the salinity ranges from low (generally 0.5 to 5 ppt) to mid-salinity (generally 5 to 16.5 ppt) (FWS 1980c).

A large number of aquatic and terrestrial species are found in and around the Savannah River near Containerport. State or Federally protected, endangered, or threatened aquatic species in the vicinity of Containerport include the Shortnose sturgeon and the Florida manatee, both identified as State and Federally endangered species. The Shortnose sturgeon uses the Savannah River as a migratory area. In addition, the Loggerhead turtle, the Bald eagle, and the American alligator are found along the lower reaches of the Savannah River (FWS, 1980c).

Both invertebrate and fish species of commercial and recreational value are found in the Savannah River. Commercial fishing is primarily for the American shad, sturgeon, shrimp, and blue crab. Public shellfishing is allowed in some areas near the mouth of the Savannah River, in the vicinity of Fort Pulaski. The Savannah River hosts the migration of several important commercial and game fishes, including the American shad, the hickory shad, and the blueback herring. Game species include the spotted seatrout, red drum, croaker, spot, striped bass, flounder, silver perch, white catfish, channel catfish, largemouth bass, sunfish, and crappies. The State of Georgia has closed the striped bass fishery for population recovery purposes (Schmitt, 1993).

There are several wildlife refuges and/or game management areas located along the lower portion of the Savannah River. Tybee National Wildlife Refuge is located at the mouth of the Savannah River at the confluence with the Atlantic Ocean. Just north of Tybee National Wildlife refuge is the Turtle Island Game Management Area. Containerport itself is located across the river from the southern end of the 10,371 ha (25,627 acre) Savannah National Wildlife Refuge. The Savannah National Wildlife Refuge and the Tybee National Wildlife Refuge are managed by the U.S. Fish and Wildlife Service.

Climatic Conditions: The area has a temperate climate, which is greatly influenced by winds coming into the area off the ocean. Nominally, 50 percent of the rainfall occurs during thunderstorms, with the remainder being equally distributed over the year and generally related to weather front passages. Severe tropical systems affect the Savannah area roughly once every 10 years and cause heavy, sustained precipitation, high winds, and extreme, but usually localized, coastal flooding. Rainfall measurements in excess of 51 cm (20 in) have been observed as a result of tropical systems impacting the area. Based on the 1951-1980 climatology, the first freeze occurs on average around November 15, and the last near March 10 (NOAA, 1992e).

The Port is subject to severe hurricanes and tropical storms, and given its proximity to Charleston, SC may have a slightly higher risk of earthquakes than the rest of the State of Georgia. The likelihood of severe natural phenomena, such as high winds and earthquakes, is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Savannah, the Uniform Building code provides a basic wind speed of about 130 km per hour (80 mi per hour). The port is located in a low seismic zone with an acceleration of 0.075 g.

Ethnic and Income Characteristics: Figure 3-34 shows the ethnic composition for the area surrounding the port at Savannah. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 49 percent of the total population, and approximately 95 percent of the minority population for the area surrounding the port. Figure 3-35 shows analogous information for low-income households residing within 16 km of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

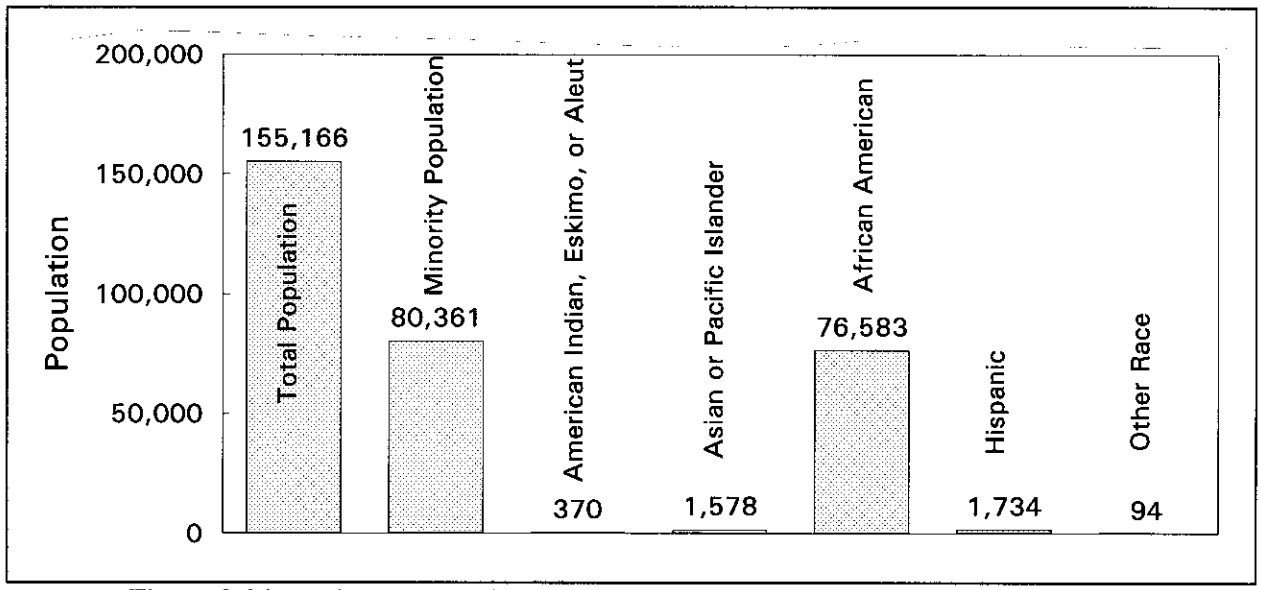

Figure 3-34 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Savannah

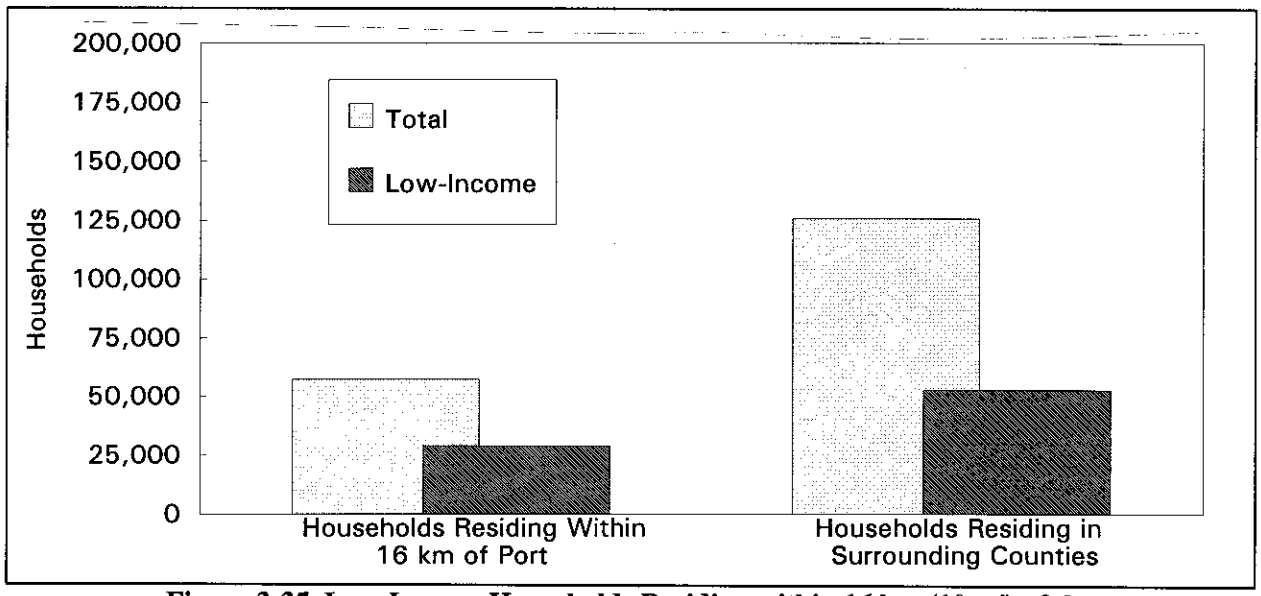

Figure 3-35 Low-Income Households Residing within 16 km (10 mi) of the Port of Savannah

3.2.1.9 Tacoma, WA

The Port of Tacoma is located in the southeastern corner of Puget Sound on the deep waters of Commencement Bay about 5 km (3 mi) from the Sound. It is a rapidly expanding major port second only to Seattle in maritime importance on Puget Sound. The distance from the entrance into Puget Sound is approximately 130 km (80 mi). A map of the port is shown in Figure 3-36.

Terminal 7, Berth D is the primary container terminal. It has one 274 m (904 ft) long container berth, 3 container cranes, and 15.2 m (50 ft) of depth alongside at mean low water.

The terminal is about 4.8 km (3 mi) from the Port of Tacoma road access to Interstate 5 immediately outside the port complex. A somewhat longer route, Interstate 5 South, connects with I-84 East near Portland, OR. Ship berths are served by the Port Belt Line Railroad, and the port is served by the Burlington Northern and Union Pacific Railroads, which interline with eastern and southern railroads.

The 1990 population within 16 km (10 mi) of the port was 511,575. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 601,000; the Oak Ridge Reservation, 431,000; the Idaho National Engineering Laboratory, 157,000; the Hanford Site, 98,600; and the Nevada Test Site, 379,000. Populations along rail routes to four of these sites are slightly larger, but the population along the rail route to the Nevada Test Site is slightly smaller (this is largely due to primary use of interstate highways through Salt Lake City, UT and Las Vegas, NV). The distances to the five potential sites on interstate routes are: the Savannah River Site, 4,720 km (2,933 mi); the Oak Ridge Reservation, 4,280 km (2,659 mi); the Idaho National Engineering Laboratory, 1,310 km (814 mi); the Hanford Site, 399 km (248 mi); and the Nevada Test Site, 2,160 km (1,342 mi). Distances along rail routes are much longer.

Environmental Conditions: A variety of marine mammals can be found in central Puget Sound including the Pacific harbor seal, California sea lion, killer whale, Dall porpoise, and harbor porpoise. In 1991, the U.S. National Marine Fisheries Services reported that the following endangered and/or threatened species may occur in the Puget Sound: the gray whale, the humpback whale, the Stellar sea lion, and the endangered leatherback sea turtle (DOE, 1995c), although these species are not reported at the port. Bald eagles can be found throughout this coastal zone, and American peregrine falcons are uncommon winter visitors (FWS, 1981a). The U.S. Fish and Wildlife Services' Ecological Inventory for the Puget Sound area indicates that the habitat of Commencement Bay is used by a variety of birds including shorebirds, gulls, sandpipers, turnstones, yellowlegs, herons, rails, great blue herons, waterfowl, loons, grebes, swans, geese, dabbling ducks, diving ducks, mergansers, American wigeons, pintails, mallards, seabirds, cormorants, alcids, common murres, and pigeon guillemots. Adult concentrations of all of these species may be found in the Bay. Some of these species may also use this area as an overwintering area, a migratory area, and/or a nesting area (FWS, 1981a). It is also indicated that adult concentrations of chinook salmon, coho salmon, chum salmon, and pink salmon are found in the Puyallup Waterway/River and use this water body and upstream segments as migratory and nursery areas.

According to the State of Washington's Department of Wildlife, a number of seabird colonies exist along the shoreline of Commencement Bay. Areas of the Puget Sound, north of Commencement Bay, are also used as haulouts by the California Sea Lion. Areas of estuarine wetlands are located along the northern shore of Commencement Bay (WDW, 1994).

Climatic Conditions: The mild climate of the Pacific Coast is modified by the Cascade Mountains and to a lesser extent by the Olympic Mountains. The climate is characterized by mild temperatures, a well-defined rainy season and prolonged cloud cover, especially during the winter months. The Cascades act as a very effective barrier in both winter and summer, shielding the region from both extreme cold and

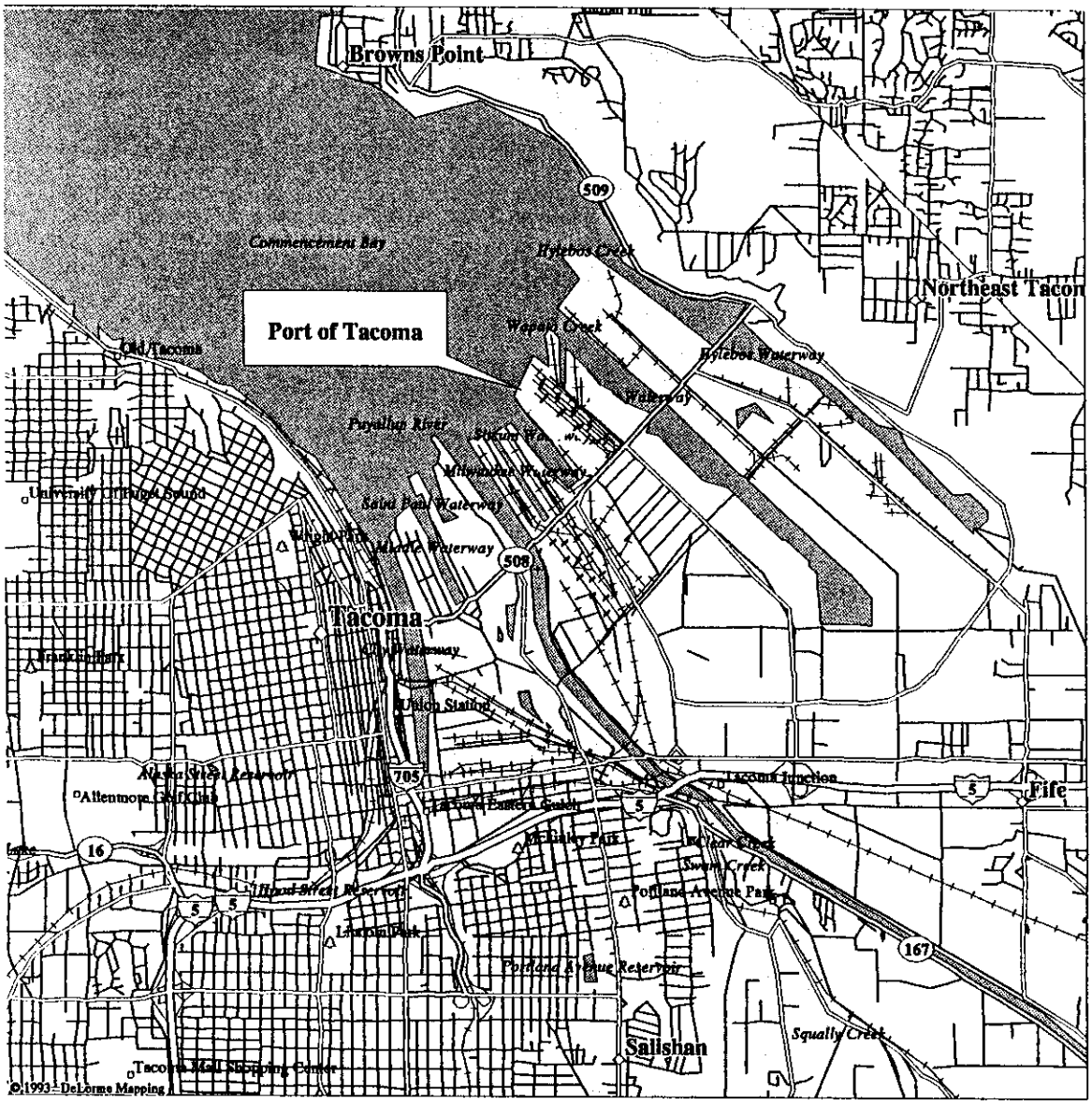

Figure 3-36 Port of Tacoma, WA

heat, respectively. The rainy season extends from October through March, with December accounting for the most rainfall. Approximately 75 percent of the annual total precipitation occurs during the winter rainy season. The dry season is centered around July and August. The majority of Seattle's precipitation is associated with normal, mid-latitude disturbances, which are most vigorous during the winter months. During summer, the dominant storm track (e.g., the polar jet) shifts northward into southern Canada, reducing the precipitation in the area. Summer thunderstorms do occur but do not contribute measurably to the annual rainfall budget. Prevailing winds are from the southwest, but occasional severe winter storms will produce strong northerly winds. Summer winds are generally rather light, with the occasional evidence of land-sea breeze effects creating northerly flows. Fog and low-level stratocumulus clouds form over the southern Puget Sound area in the late summer, fall, and early winter months, and often dominate the weather conditions of the early morning hours, reducing surface visibility. Based on 1951-1980 climatology, the first occurrence of freezing temperatures should occur around November 11, and the last incidence in spring around March 24 (NOAA, 1992f).

The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code. For the Port of Tacoma, the Uniform Building Code provides a basic wind speed of about 130 km per hour (80 mph) (UBC, 1991). The port is located in a high seismic zone with an acceleration of 0.30 g. There have been two major earthquakes in the Puget Sound area this century (Bolt, 1978). On May 18, 1980, Mount St. Helens suffered a major volcanic eruption (IPA, 1993). All the mountains along the Cascade Range from Canada to Northern California are volcanic in origin and are potentially active.

Ethnic and Income Characteristics: Figure 3-37 shows the ethnic composition for the area surrounding the port at Tacoma, WA. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans constituted the largest minority group at about 6 percent of the total population, and approximately 38 percent of the minority population for the area surrounding the port. Asian and Hispanic minorities make up approximately 33 percent and 20 percent, respectively, of the minority population. Native Americans make up about 8 percent of the minority population near the port of Tacoma. Figure 3-38 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

3.2.1.10 Wilmington, NC

The Port of Wilmington, NC, is located on the east bank of the Cape Fear River, about 42 km (26 mi) above its mouth. It is the leading port of North Carolina, and its major export is wood pulp. The major terminals are down river from the city. A Federal project maintains a 12.2 m (40 ft) channel at the mouth of the Cape Fear River, 11.6 m (38 ft) to the port. A new dredging program will deepen the approach channel to 12.2 m (40 ft). A map of the port is shown in Figure 3-39.

The Wilmington wharves are of concrete pile construction, rubber fendered, with a total frontage of about 2,000 m (6,600 ft). Berths 6 to 9 are dedicated containership berths, with the remaining berths used for various kinds of general cargo. All of the main cargo berths have a depth alongside of 11.6 m (38 ft) at mean low water. The terminal has five container cranes, plus three gantry cranes (Jane's, 1992; AAPA, 1993; FHI, 1993).

Truck shipments from the port to southern destinations are along U.S. Routes 17, 74, 76, and 421 to Interstates 95 and 40 (POW, 1994). Northern and western long-distance routes are via Interstate 40, which connects with State Highway 132 about 16 km (10 mi) north of the city. The 1990 population within

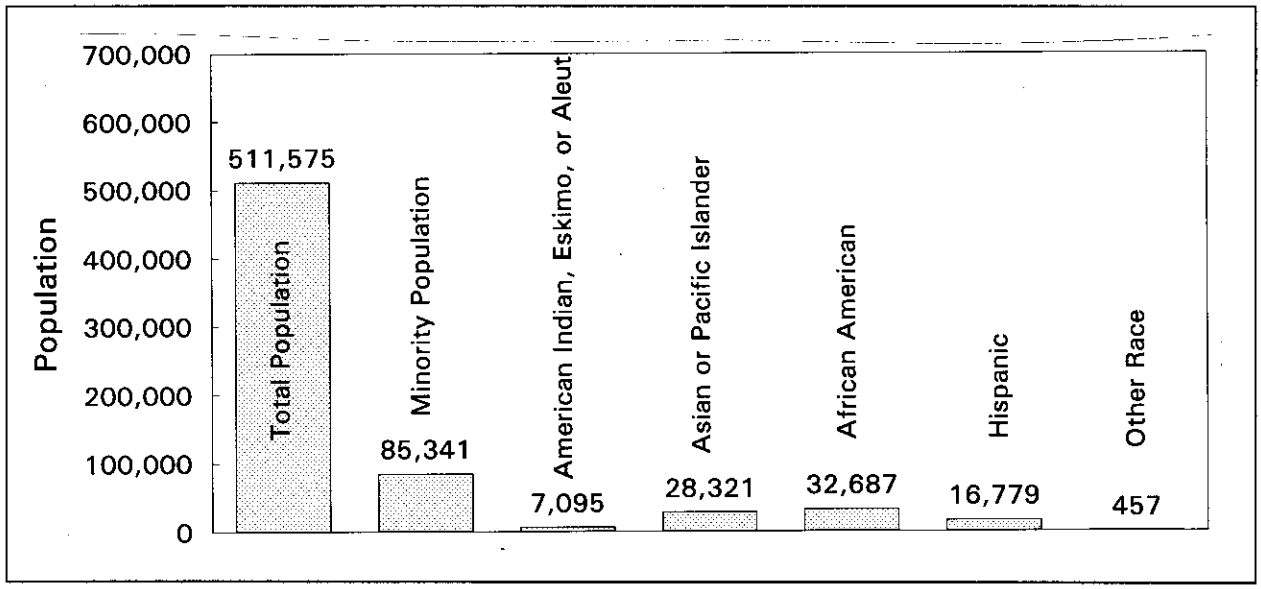

Figure 3-37 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Tacoma

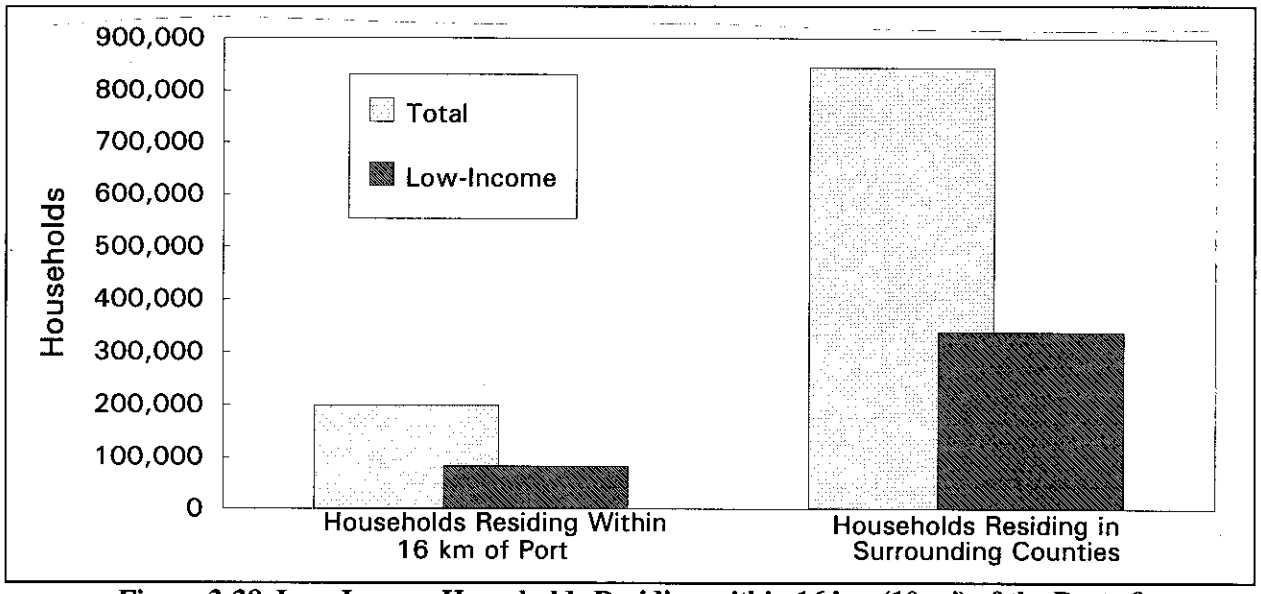

Figure 3-38 Low-Income Households Residing within 16 km (10 mi) of the Port of Tacoma

16 km (10 mi) of the port terminals was 115,057. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: the Savannah River Site, 64,700; the Oak Ridge Reservation, 128,000; the Idaho National Engineering Laboratory, 507,000; the Hanford Site, 556,000; and the Nevada Test Site, 570,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: the Savannah River Site, 500 km (311 mi); the Oak Ridge Reservation, 820 km (510 mi); the Idaho National Engineering Laboratory, 4,100 km (2,548 mi); the Hanford Site, 4,770 km (2,964 mi); and the Nevada Test Site, 4,260 km (2,647 mi). Distances along rail routes are slightly longer for western sites, but about the same for eastern sites.

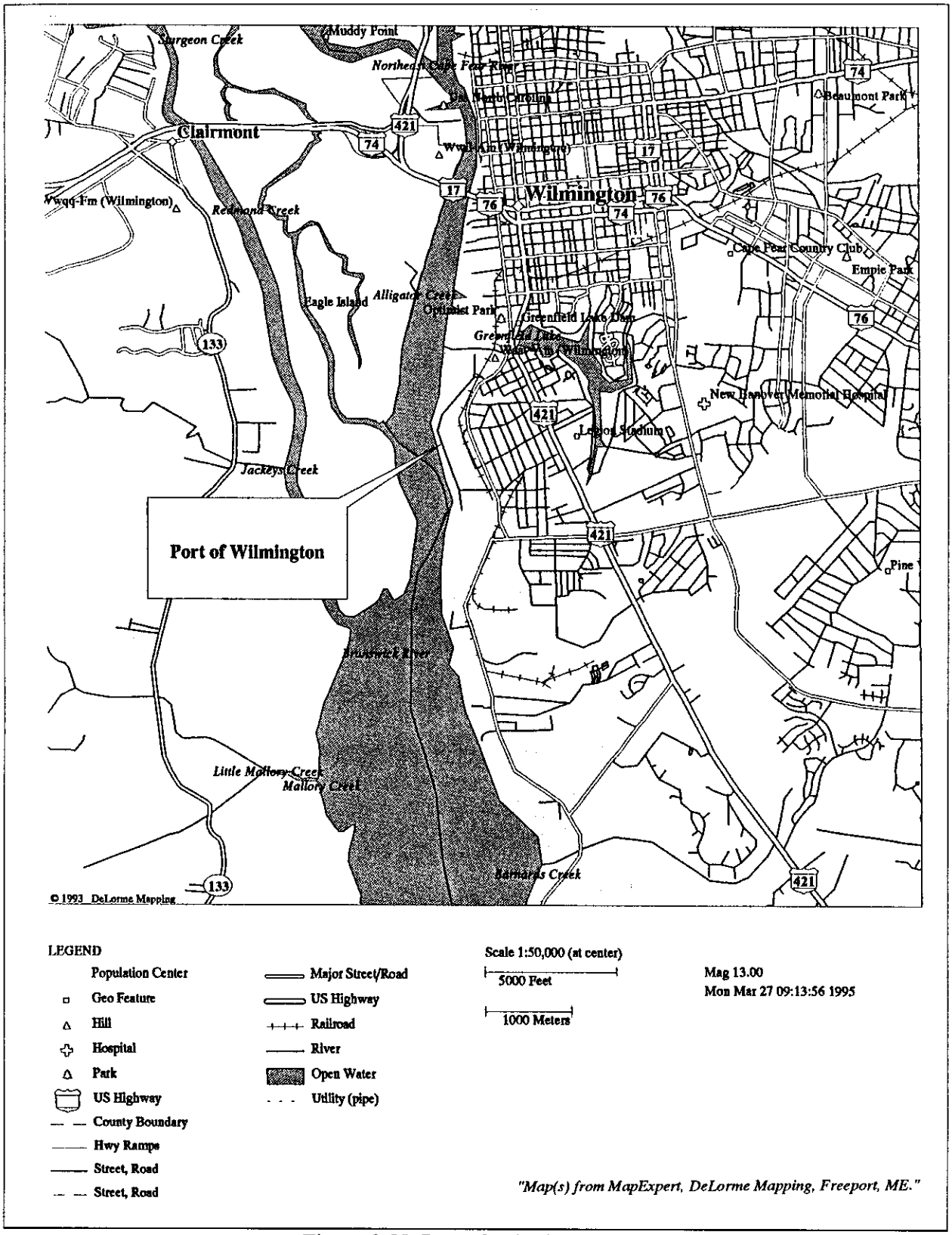

Figure 3-39 Port of Wilmington, NC

Environmental Conditions: There are no known environmentally sensitive areas in the immediate vicinity of the terminal, but due to resorts and recreational activity, there is heightened environmental awareness.

North Carolina has given the lower portion of the Cape Fear River three different stream classifications. From the Northeast Cape Fear River to the confluence with the Cape Fear River the waters are classified as SC-swamp. From the mouth of the Northeast Cape Fear to a point between Snow and Federal Points, the waters are classified as SC, and from Snow and Federal Points oceanward the waters are classified as SA. SC waters are tidal waters suitable for fishing, fish and wildlife propagation, secondary recreation, and other water uses requiring lower quality. The term "swamp" denotes waters with slow velocity. Class SA waters are suitable for shellfishing and primary recreation, as well as all of the activities approved for Class SC waters. According to the U.S. Fish and Wildlife Service's Ecological Inventory Map for Beaufort, NC, the Port of Wilmington is located in a low salinity estuarine habitat (generally 0.5 to 5 ppt) and tidal freshwater habitat. Below Wilmington at Campbell Island, the river changes to a mid-salinity estuarine habitat (generally 5 to 16.5 ppt). The Cape Fear River near MOTSU changes once again to a high-salinity estuarine habitat (generally 16.5 to 30 ppt).

The lower Cape Fear River supports a large number of aquatic and terrestrial species. There are both invertebrate and fish species of commercial and recreational value found in the Cape Fear River near the Port of Wilmington. Species sought by commercial and recreational fishermen include flounder, trout, spot, croaker, bluefish, Spanish mackerel, and king mackerel. Shellfish sought include penaeid shrimp and blue crabs.

The Natural Heritage Program of the North Carolina Department of Environment, Health and Natural Resources reports that the area around the port has not been systematically inventoried for rare species. However, they also report that the lower Cape Fear River, from Wilmington to the mouth of the river at Smith Island, is brackish and contains numerous rare animals. The shortnose sturgeon (State and Federal Endangered Species) rarely occurs in the river, whereas manatees (State and Federal Endangered Species) occasionally occur, especially in the summer. American alligators (a designated threatened species) can be found in tributary streams. The freckled blenny, spinycheek sleeper, opossum pipefish, and marked goby are other rare marine fishes that inhabit the river.

There are many animals with special status in this area including various types of whales, sea turtles, and birds. State or Federally protected, endangered, or threatened aquatic species in this area include the shortnose sturgeon (fish), finback whale, Florida manatee, humpback whale, right whale, sei whale, and sperm whale (mammals), Arctic peregrine falcon, bald eagle, piping plover, red-cockaded woodpecker, wood stork (birds), and the American alligator, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and the loggerhead sea turtle (reptiles and amphibians).

Climatic Conditions: The Port of Wilmington is located on the Cape Fear River, 42 km (26 mi) from the open Atlantic Ocean. This general area also includes MOTSU, which is also located on the Cape Fear River, north of Southport, NC, and south of Wilmington, NC. The elevation of this region is approximately 12 m (40 ft) above sea level, and is more variable than the coastal plain surrounding the Norfolk, VA area. The National Weather Service has been archiving meteorological information for this area since 1871.

The port is subject to hurricanes and tropical storms. The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code. For the Port of Wilmington, the Uniform Building Code provides a basic wind speed of about 160 km per hour (100 mph) (UBC, 1991). The port is located in a low seismic zone with an acceleration of 0.075 g.

The maritime location of the Wilmington area makes the climate unusually mild for its northern latitude. All wind directions from the east-northeast through the southwest have some moderating effect on the local climate, due to the relatively warm and cool ocean in the winter and summer seasons, respectively. The area rarely experiences cold episodes where the temperature falls below -18°C (0°F). However, cold air outbreaks do occur, causing sharp fluctuations in winter temperatures. Rainfall in the area is generally considered ample and evenly distributed throughout the year, with the bulk of the precipitation occurring during the summer months. The bulk of this rainfall is generally associated with afternoon and evening thunderstorms. In contrast, the winter rains tend to be of the slow, steady type, generally lasting one to two days. As is common at Atlantic coastal localities at this latitude, the late summer and early fall months bring the possibility of hurricanes and tropical storms to the Wilmington area. These storms are capable of generating high winds, above normal tides and torrential rains. The latter two are also capable of creating widespread local flooding of low-lying coastal areas (NOAA, 1992g).

Ethnic and Income Characteristics: Figure 3-40 shows the ethnic composition for the area surrounding the port at Wilmington. This figure shows the population residing within 16 km (10 mi) of the port according to 1990 data published by the U.S. Bureau of the Census. At the time of the 1990 census, African Americans made up about 33 percent of the total population, and approximately 93 percent of the minority population for the area surrounding the port. Figure 3-41 shows analogous information for low-income households residing within 16 km (10 mi) of the port. As discussed in Appendix A, the percentage of low-income households near the port is nearly the same as that for counties surrounding the port.

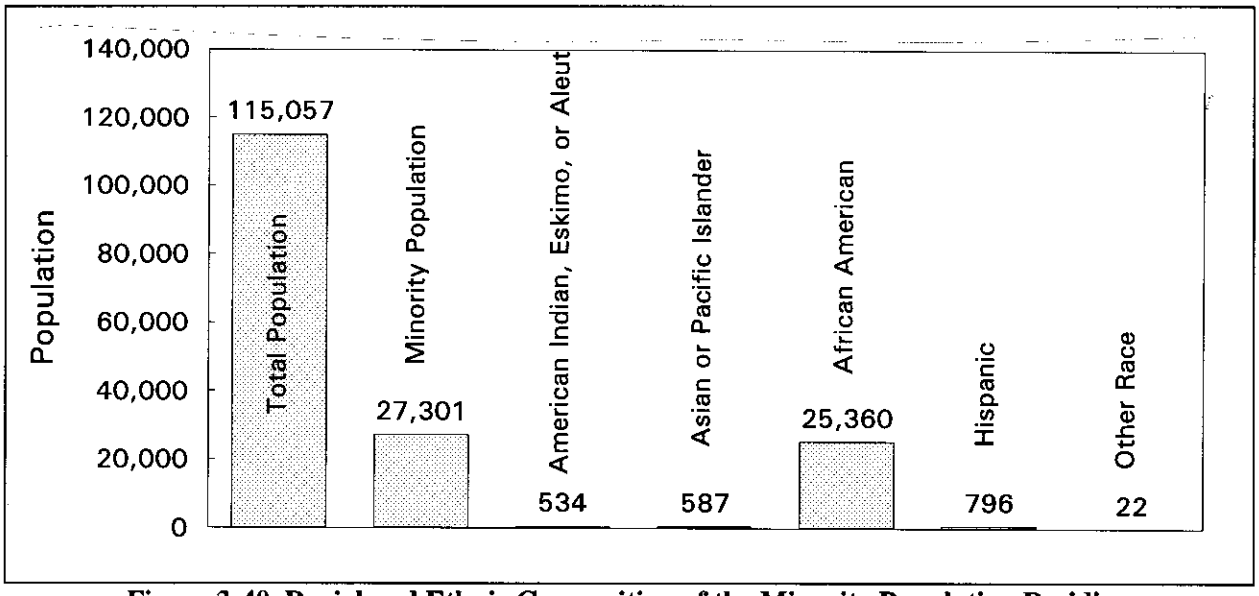

Figure 3-40 Racial and Ethnic Composition of the Minority Population Residing within 16 km (10 mi) of the Port of Wilmington

3.3 Management Site(s) Environments

This section describes the affected environment of the five potential DOE management sites for the foreign research reactor spent nuclear fuel. The five management sites are the Savannah River Site, the Idaho National Engineering Laboratory, the Hanford Site, the Oak Ridge Reservation, and the Nevada Test Site.

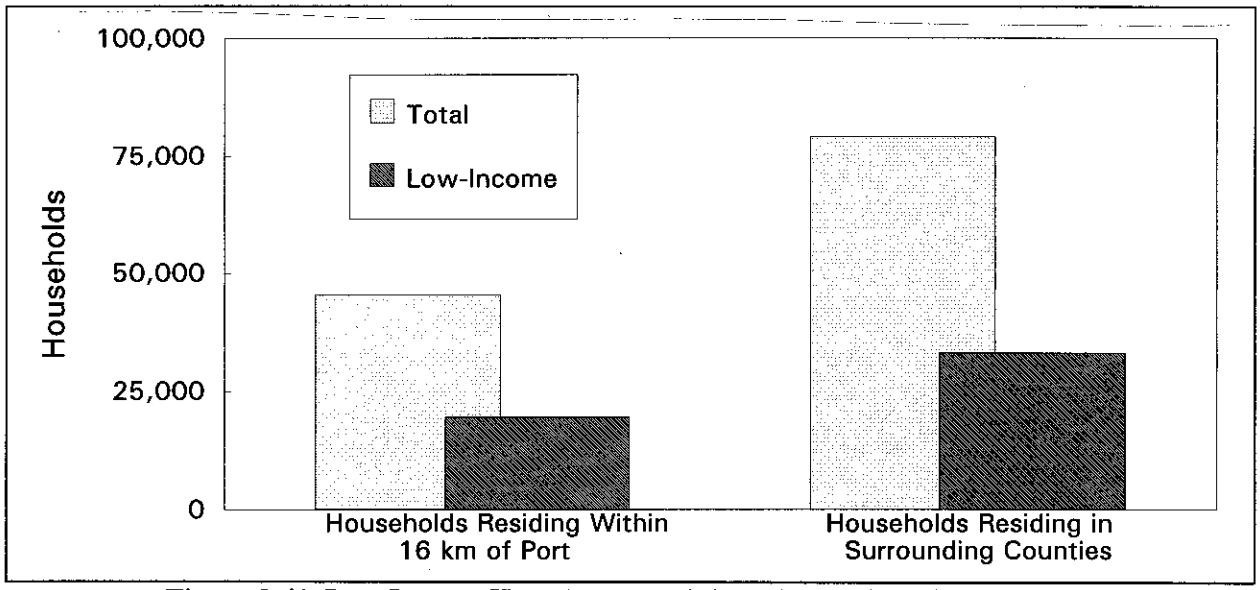

Figure 3-41 Low-Income Households Residing within 16 km (10 mi) of the Port of Wilmington

3.3.1 Description of the Affected Environment at the Savannah River Site

The Savannah River Site is a key DOE facility for research and production of special nuclear materials. The site was built in the early 1950's to produce the basic materials used in the fabrication of nuclear weapons. The DOE Savannah River Operations Office manages the Savannah River Site, and the Westinghouse Savannah River Company operates the site under contract to DOE. This section describes the potentially affected environment of the Savannah River Site. The location of the site is shown in Figure 3-42.

3.3.1.1 Geology

The Savannah River Site is located in the Upper Atlantic Coastal Plain physiographic province of western South Carolina, approximately 32 km (20 mi) southeast of the Fall Line, which separates the Piedmont and Coastal Plain provinces (Figure 3-42). The Coastal Plain in South Carolina is subdivided to include the Aiken Plateau, the Congaree Sand Hills, and the Coastal Terraces. The Coastal Plain consists of 213 to 366 m (700 to 1,200 ft) of gently seaward (southeast) dipping sands, clays, and limestones of Cretaceous and Tertiary age. These sediments are underlain by sandstones of Triassic age and older dense metamorphic and igneous basement rocks (Arnett et al., 1993). Coastal Plain sediments form a wedge of seaward-dipping and thickening unconsolidated and semi-consolidated sediments that begin at zero at the Fall Line and increase to more than 1,212 m (4000 ft) at the Continental Shelf. The Coastal Plain sediments underlying the Savannah River Site consist of sandy clays and clayey sands, with occasional beds of clean sand, gravel, clay, or carbonate. Two bioclastic limestone zones ranging from 0.6 m (2 ft) to 24 m (80 ft) occur within the Tertiary sequence. Most of the clastic sediments are unconsolidated, but thin semi-consolidated beds also occur (DOE, 1991a). The Triassic formations and older igneous and metamorphic rocks are hydrologically separated from the overlying Coastal Plain sediments by a regional aquitard (Arnett et al., 1993) (Figure 3-43).

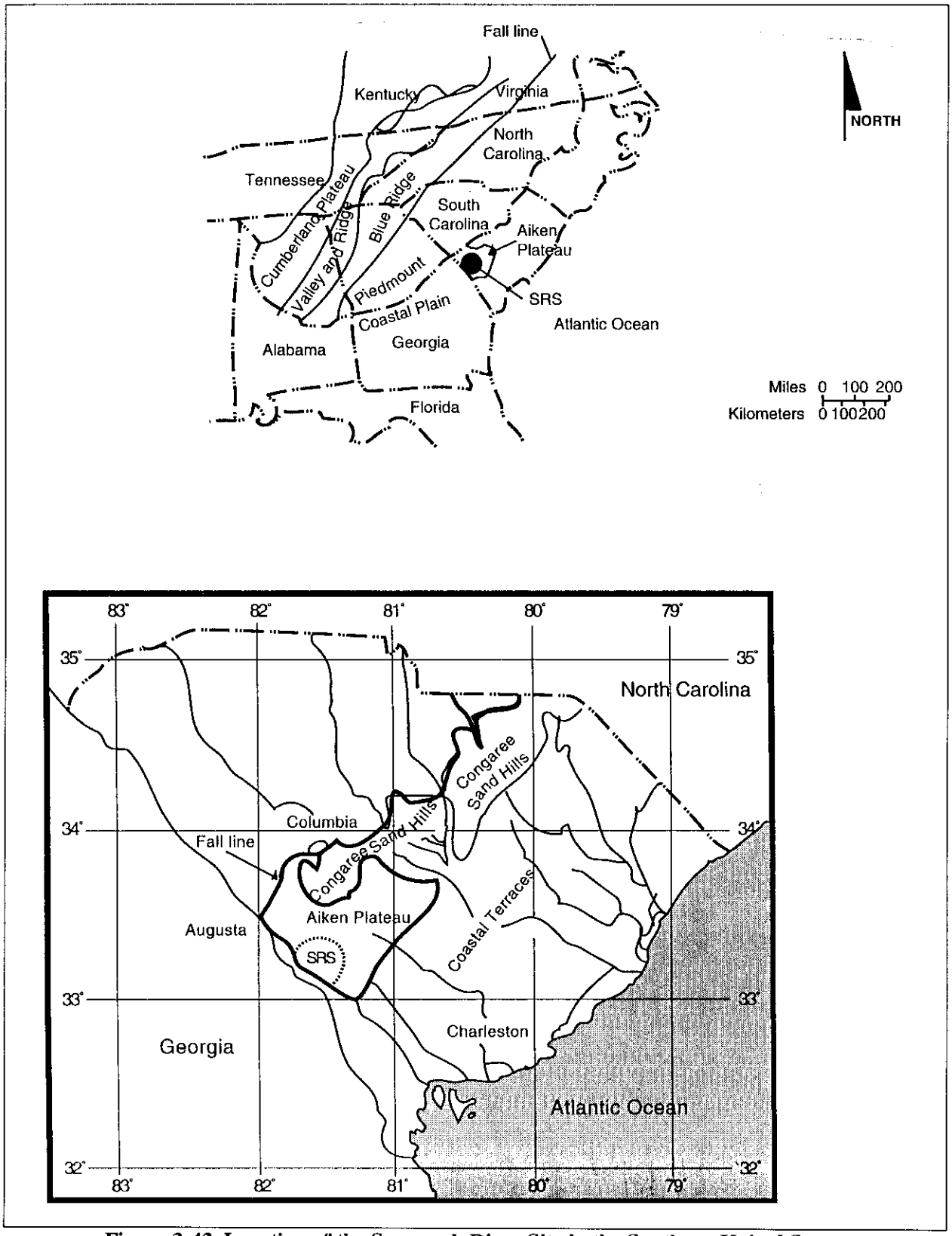

Figure 3-42 Location of the Savannah River Site in the Southern United States

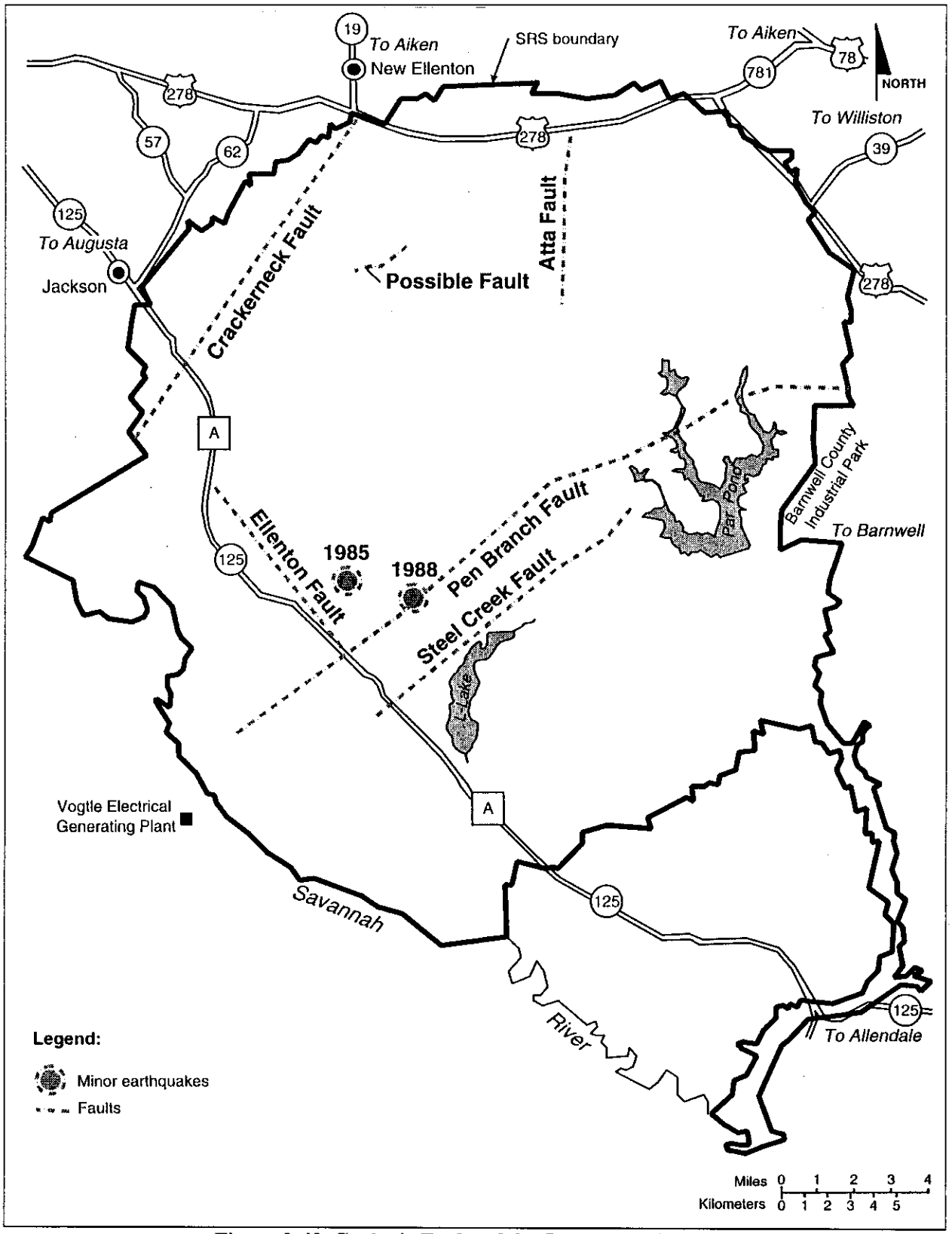

Figure 3-43 Geologic Faults of the Savannah River Site

3.3.1.2 Seismology and Volcanology

Seismicity in the Coastal Plain of South Carolina occurs in three distinct seismic zones near the Charleston area: Middleton Place Summerville, about 19 km (12 mi) northwest of Charleston; Bowman, about 59 km (37 mi) northwest of the Middleton Place-Summerville; and Adams Run, about 30 km (19 mi) southwest of the Middleton Place-Summerville (WSRC, 1993a). Of the three seismic zones within the Coastal Plain province, the Charleston area has been and remains the most seismically active. The Charleston area is also the most significant source of seismicity affecting the Savannah River Site, both in terms of maximum historic site intensity and the number of earthquakes felt in the area (WSRC, 1993a).

The closest offsite fault system is the Augusta Fault Zone, approximately 40 km (25 mi) from the Savannah River Site. In this fault zone, the Belair Fault has experienced the most recent movement, but is not considered capable of generating major earthquakes (DOE, 1987). There is no conclusive evidence of recent displacement along any fault within 320 km (200 mi) of the Savannah River Site, with the possible exception of the buried faults in the epicentral area of the 1886 Charleston, SC earthquake, approximately 144 km (90 mi) away (DOE, 1991a).

Two notable earthquakes have occurred within 320 km (200 mi) of the Savannah River Site. The first was a major earthquake in 1886 centered in the Charleston area, which had an estimated Richter magnitude of 6.8. The second earthquake was the Union County, SC earthquake of 1913, which had an estimated Richter magnitude of 6.0, and occurred about 160 km (100 mi) from the Savannah River Site (WSRC, 1993a).

Two earthquakes have occurred at the Savannah River Site during recent years. In June 1985, onsite instruments recorded an earthquake with a magnitude of 2.6 and a focal depth of about 1.0 km (0.6 mi) (DOE, 1995c). The epicenter was just west of the C- and K-areas. In August 1988, an earthquake of magnitude 2.0 and a focal depth of approximately 2.7 km (1.7 mi) occurred (Stephenson, 1988).

3.3.1.3 Hydrology

3.3.1.3.1 Surface Water

The Savannah River bounds the Savannah River Site on its southwestern border for about 32 km (20 mi), approximately 260 river km (160 river mi) from the Atlantic Ocean. At the Savannah River Site, the Savannah River flow averages about 283 m^3 per sec (74,760 gal per sec). Five principal tributaries to the Savannah River are found on the Savannah River Site: Upper Three Runs Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek (Figure 3-44). These tributaries drain almost all of the Savannah River Site. Each of these streams originates on the Aiken Plateau in the Coastal Plain, and descends 15 to 60 m (50 to 200 ft) before discharging into the river. The streams, which historically have received varying amounts of discharge from the Savannah River Site operations, are not commercial sources of water. The natural flow of the Savannah River Site streams ranges from less than 1 m^3 per sec (264 gal per sec) in smaller streams such as Pen Branch to 6.8 m^3 per sec (1,795 gal per sec) in Upper Three Runs. Three large upstream reservoirs - Hartwell, Richard B. Russell, and Strom Thurmond - minimize the effects of droughts and the impacts of low flow on downstream water quality and fish and wildlife resources in the Savannah River.

Surface Water Quality: The Savannah River, which forms the boundary between the States of Georgia and South Carolina, supplies potable water to several users. Upstream of the Savannah River Site, the river supplies domestic and industrial water needs for Augusta, GA, and North Augusta, SC. Downstream

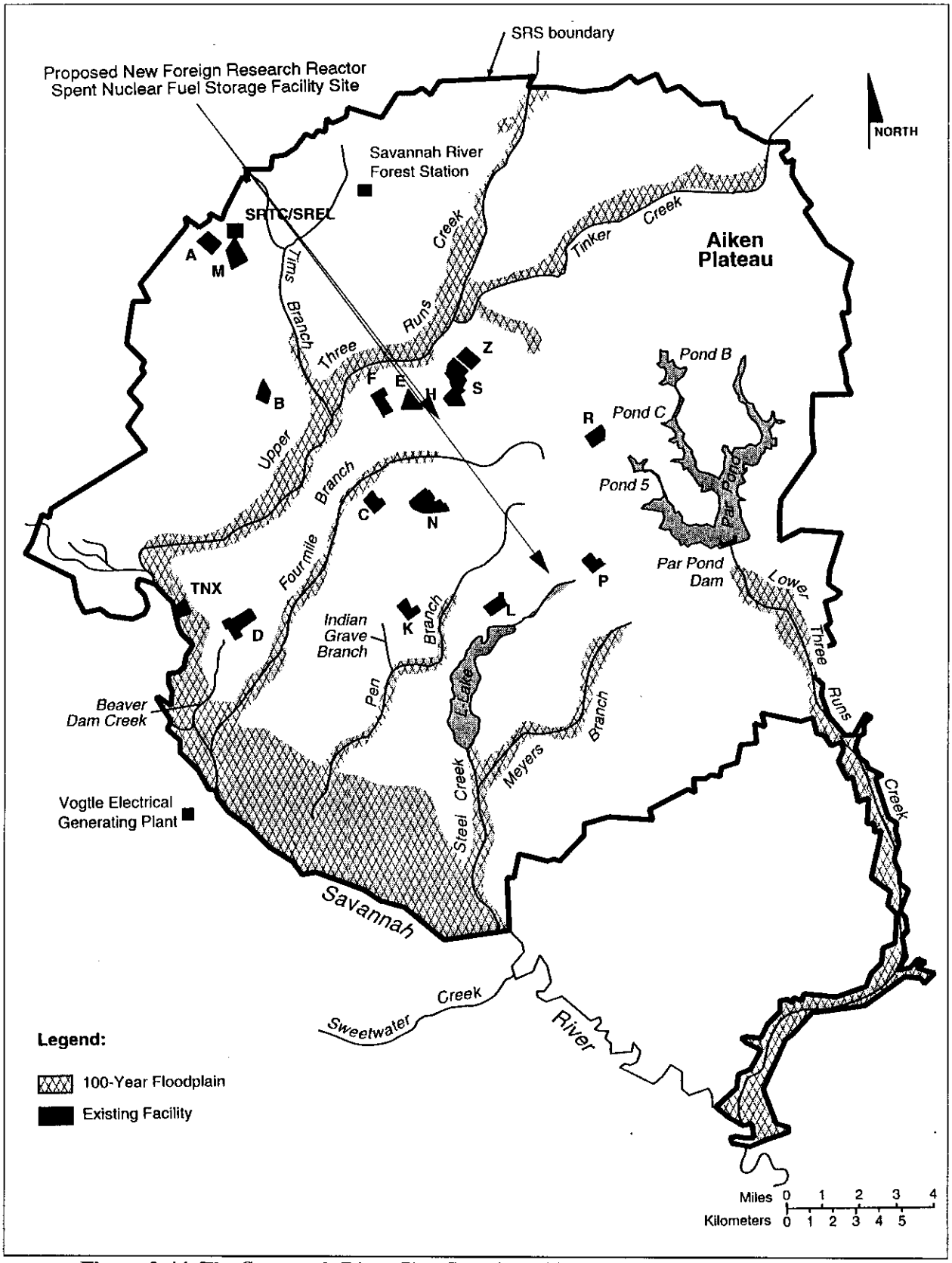

Figure 3-44 The Savannah River Site, Showing 100-Year Floodplain, Major Stream Systems and Facilities

of the Savannah River Site, the river supplies domestic and industrial water needs for Savannah, GA, and Beaufort and Jasper Counties in South Carolina. The South Carolina Department of Health and Environmental Control regulates the physical properties and concentrations of chemicals and metals in the Savannah River Site effluent under the National Pollutant Discharge Elimination System. This department also regulates chemical and biological water quality standards for the Savannah River Site waters. On April 24, 1992, the department changed the classification of the Savannah River and the Savannah River Site streams from "Class B waters" to "Freshwaters." The definitions of "Class B" waters and "Freshwaters" are the same, but the Freshwaters classification imposes a more stringent set of water quality standards (Arnett et al., 1993). Tables 4-10 and 4-11 of Appendix C, Volume 1 of the Programmatic SNF&INEL Final EIS list the characteristics of the Savannah River Site surface water quality (DOE, 1995c).

3.3.1.3.2 Groundwater

There are two hydrogeologic provinces in the subsurface beneath the Savannah River Site. The deepest Piedmont hydrogeologic province includes Paleozoic metamorphic and igneous basement rocks, and Triassic-aged lithified mudstone and sandstone. The Southeastern Coastal Plain hydrogeologic province lies above the Piedmont province and consists of a seaward thickening wedge of unconsolidated sediments of Late Cretaceous and Tertiary age. The Southeastern Coastal Plain hydrogeologic province is more important from a resource point of view because it holds an abundant supply of high-quality groundwater.

The sediments that make up the Southeastern Coastal Plain hydrogeologic province in west-central South Carolina are grouped into three major aquifer systems divided by two major confining systems, all of which are underlain by the Appleton confining system. The Appleton system separates the Southeastern Plain hydrogeologic province from the underlying Piedmont hydrogeologic province. Locally, individual aquifer and confining units are delineated. The complexly interbedded strata that form the three aquifer systems primarily consist of fine-to-coarse-grained sand and local gravel and limestone deposited under relatively high energy conditions in fluvial to shallow marine environments.

The water table receives water through rainfall percolating through the vadose zone. The deeper semi-confined aquifers receive water from groundwater flow into the Savannah River Site from offsite or from water flowing from aquifers above or below. The direction of groundwater flow in the vadose zone is predominantly downward, but some lateral flow occurs because of clay lenses in the soil. The flow of groundwater in the water table and deeper semi-confined aquifers is controlled by the hydraulic properties of the sediments (e.g., conductivity) and the proximity to streams. Savannah River ultimately receives all groundwater that flows beneath the Savannah River Site, and no contaminated groundwater is flowing off of the Savannah River Site.

Groundwater Quality: The quality of groundwater in the principal hydrologic systems beneath the Savannah River Site depends on both the source of the water and the inorganic and biochemical reactions that take place along its flowpath. Quality is strongly influenced by the chemical composition and mineralogy of the enclosing geologic materials (WSRC, 1993b). In general, the quality of the groundwater in the Coastal Plain sediments at the Savannah River Site and the surrounding areas is suitable for most domestic and industrial purposes. The waters are dilute with respect to total dissolved solids concentrations, which range from less than 10 mg per L to about 150 to 200 mg per L. The pH values range from as low as 4.9 to a maximum value of 7.7 (where the groundwater is in contact with limestone). Due to the low solids content of the waters and the frequently low pH values, many of the waters are corrosive to metal surfaces. High dissolved iron concentrations can also be of concern in some units. An onsite degasification and filtration process raises the pH and removes iron in domestic water

supplies where necessary (WSRC, 1993b). Table 4-12 of Appendix C, Volume 1 of the Programmatic SNF&INEL Final EIS summarizes the Savannah River Site groundwater quality data, and Table 4-13 lists data for radiological constituents (DOE, 1995c).

The groundwater beneath 5 to 10 percent of the Savannah River Site has been contaminated by industrial solvents, metals, tritium, or other constituents used or generated on the site. Figure 3-45 shows the locations of facilities monitored by the Savannah River Site and areas with constituents that exceeded drinking water standards in 1992. In general, contaminated groundwater at the Savannah River Site is beneath a few facilities, and the contaminants reflect operations and chemical processes at those facilities. For example, contaminants in the groundwater beneath A- and M-Areas include chlorinated volatile organics, radionuclides, metals, and nitrate. At F- and H-Areas, contaminants in the groundwater include tritium and other radionuclides, metals, nitrate, chlorinated volatile organics (at values much smaller than found at A- and M-Areas), and sulfate. The groundwater beneath the Sanitary Landfill contains chlorinated volatile organics, radionuclides, and metals. The groundwater beneath all the reactor areas except R-Area contains tritium, other nuclides, metals, and chlorinated volatile organics, and at R-Area, groundwater contaminants include radionuclides and cadmium. The groundwater beneath D-Area contains metals, radionuclides, sulfate, and chlorinated volatile organics. At TNX-Area, the groundwater contains chlorinated volatile organics, radionuclides, and nitrate (Arnett et al., 1993).

The McQueen Branch aquifer, which becomes shallower toward the Fall Line, forms the base for most municipal and industrial water supplies in Aiken County. Toward the coast, in Allendale and Barnwell Counties, this aquifer exists at increasingly greater depths. As a consequence, the shallower Gordan aquifer supplies some municipal, industrial, and agricultural users. The Gordan and Upper Three Runs Creek aquifers are the primary sources of domestic water supplies in the vicinity of the Savannah River Site for rural non-municipal water. DOE has identified 56 major municipal, industrial, and agricultural groundwater users within 32 km (20 mi) of the center of the Savannah River Site (DOE, 1987). The total pumpage for these users is about 136,260 m^3 per day (36 million gal per day).

Excellent quality groundwater is abundant in this region of South Carolina from many local aquifer units. As a result, the South Carolina Department of Health and Environmental Control has classified all aquifers in the State as Class GB (DOE, 1995c), or U.S. Environmental Protection Agency Class II, meaning that the aquifers can provide resource-quality water, but are not the sole source of supply (as are South Carolina Class GA or U.S. Environmental Protection Agency Class 1 aquifers) (DOE, 1991a).

3.3.1.4 Meteorology

Wind: Figure 3-46 shows annual wind direction frequencies and wind speeds for the Savannah River Site from 1987 through 1991. The maximum wind directional frequencies are from the northeast and west-southwest. The average wind speed for this 5-yr period was 3.8 m per sec (8.5 mph). Calm winds (less than 2 m per sec or 4.5 mph) occurred less than 10 percent of the time during the 5-yr period. Seasonally, wind speeds were greatest during the winter at 4.1 m per sec (9.2 mph), and lowest during the summer at 3.4 m per sec (7.6 mph) (Shedrow, 1993). Winter snow storms in the Savannah River Site area occasionally bring strong and gusty surface winds with speeds as high as 32 m per sec (72 mph). Thunderstorms can generate winds with speeds as high as 18 m per sec (40 mph) and even stronger gusts. The fastest wind speed recorded at Augusta between 1950 and 1986 was 37 m per sec (83 mph) (DOE, 1995c).

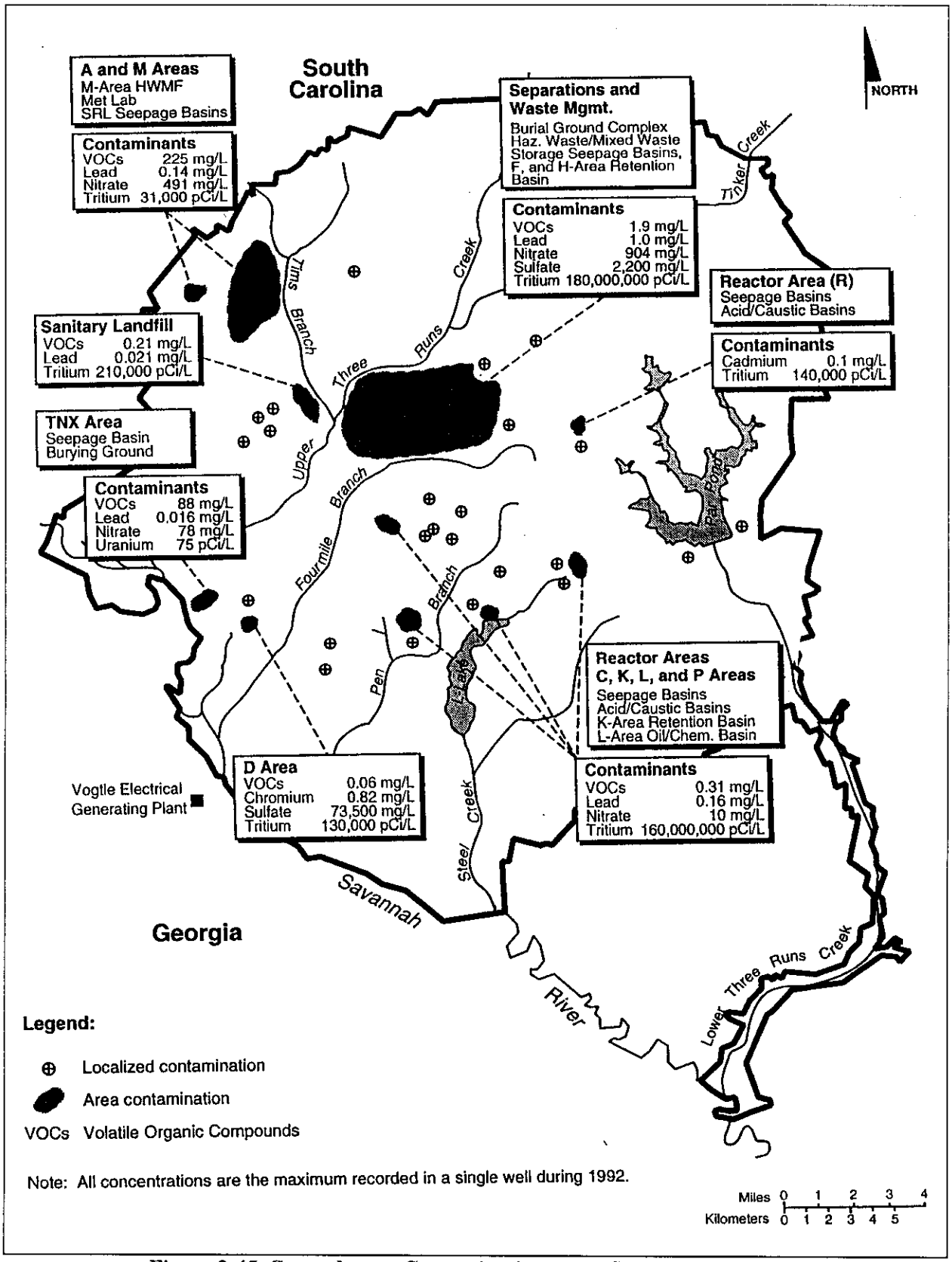

Figure 3-45 Groundwater Contamination at the Savannah River Site

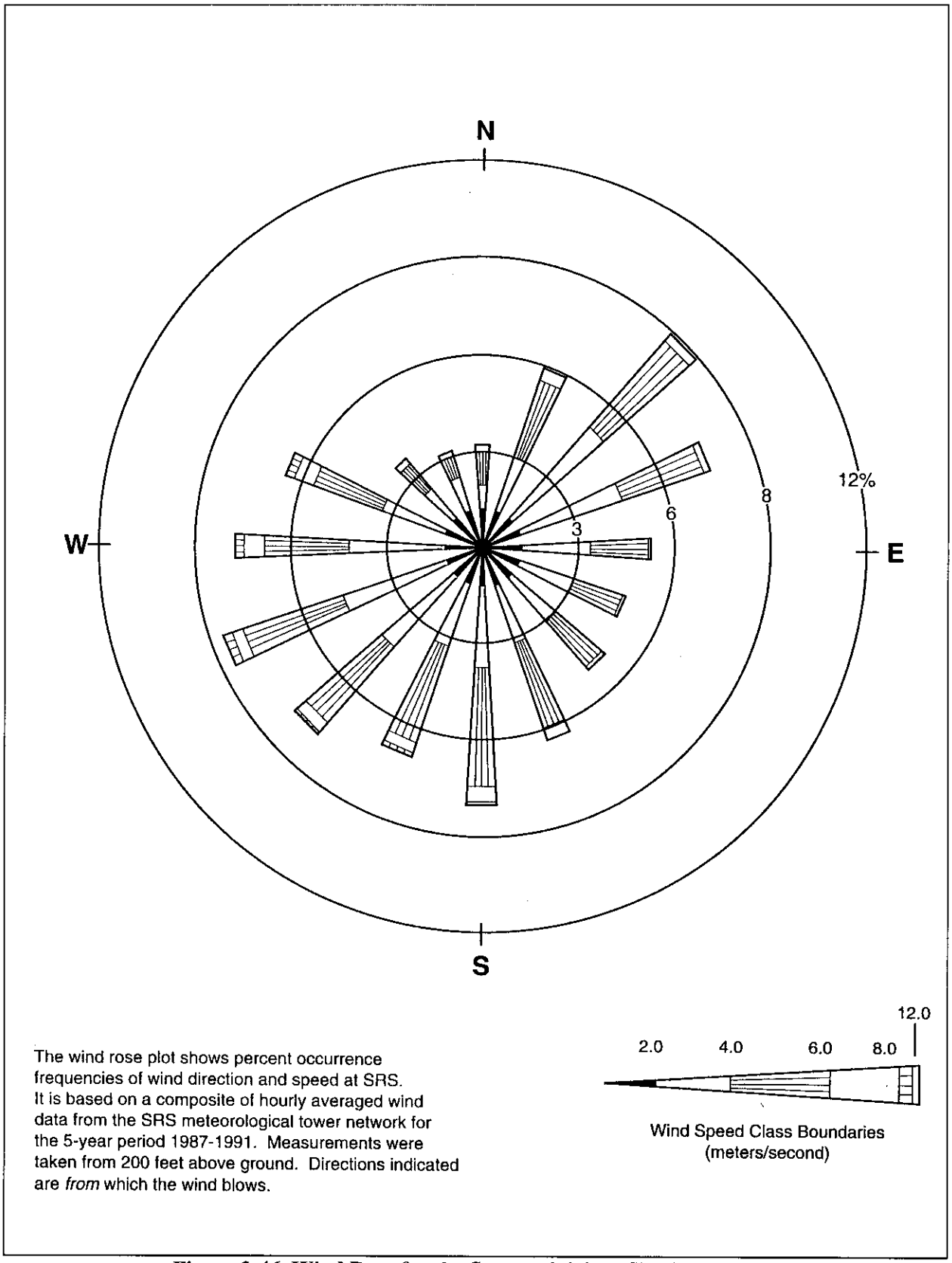

Figure 3-46 Wind Rose for the Savannah River Site (1987-1991)

Temperature and Humidity: The annual average temperature at the Savannah River Site is 17.8°C (64°F), and monthly averages range from a low of 7.22°C (45°F) in January to a high of 27.2°C (81°F) in July. Average daily relative humidity ranges from a maximum of 90 percent in the morning to a minimum of 43 percent in the afternoon on an annual basis.

Precipitation: The average annual precipitation at the Savannah River Site is approximately 121.9 cm (48 in). Precipitation distribution is fairly even throughout the year, with the highest precipitation in the summer [36.1 cm (14.2 in)] and the lowest in autumn [22.5 cm (8.8 in)] (Arnett et al., 1993). Snowfall has occurred in the months of October through March, with the average annual snowfall at 3.0 cm (1.2 in). Large snowfalls are rare (DOE, 1995c).

The area encompassing the Savannah River Site experiences an average of 56 thunderstorm days per year. From 1954 to 1983, 37 tornadoes were reported for a one-degree square of latitude and longitude that includes the Savannah River Site. This frequency of occurrence is equivalent to an average of about one tornado per year. The estimated probability of a tornado striking a point on the Savannah River Site is 0.00007 per year, which is less than one in ten thousand (DOE, 1995c). Since operations began at the Savannah River Site in 1953, nine tornadoes have been confirmed on or near the site. Winds exceeding hurricane force have been observed only once at the Savannah River Site (Hurricane Gracie in 1959) (Shedrow, 1993).

Atmospheric Dispersion: Based on measurements at onsite meteorological stations, dispersion conditions in the Savannah River Site region were classified unstable approximately 56 percent of the time, neutral 23 percent of the time, and stable about 21 percent of the time. On an annual basis, inversion conditions occur 21 percent of the time at the Savannah River Site (Shedrow, 1993).

Air Quality: The local air quality management region which includes the Savannah River Site is in attainment with National Ambient Air Quality Standards for criteria pollutants, which include sulfur dioxide, nitrogen oxides, particulate matter, lead, ozone (as volatile organic compounds), and carbon monoxide (EPA, 1993a). This region has a Class II designation under Prevention of Significant Deterioration regulations (EPA, 1993b), which allows moderate industrial growth to occur. No areas within an 80 km (50 mi) radius of the site are designated as Prevention of Significant Deterioration Class I (e.g., national parks, wildlife refuge). Class I areas place severe restrictions on new sources that might affect ambient air quality. The States of South Carolina and Georgia perform ambient air monitoring near the Savannah River Site, and have reported no significant exceedances of National Ambient Air Quality Standards.

In the Savannah River Site region, airborne radionuclides originate from natural resources (terrestrial or cosmic), worldwide fallout, and the Savannah River Site operations. The Savannah River Site maintains a network of air monitoring stations on and around the site to determine the concentrations of radioactive particulates and aerosols in the air (Arnett et al., 1993). Table 4-6 of Appendix C, Volume 1 of the Programmatic SNF&INEL Final EIS lists average and maximum atmospheric radionuclide particulate concentrations at the Savannah River Site boundary, and background [160 km (100 mi)] monitoring locations in 1991 (DOE, 1995c). Tritium is the only radionuclide of the Savannah River Site origin that can be detected routinely in offsite air samples above background.

3.3.1.5 Ecology

When the U.S. Government acquired the Savannah River Site in 1951, the site was approximately two-thirds forested and one-third cropland and pasture (Dukes, 1984). At present, more than 90 percent of the Savannah River Site is forested. With the exception of the Savannah River Site production and support

areas, natural succession has reclaimed other previously disturbed areas. Satellite imagery of the site shows a circle of wooded habitat within a matrix of cleared uplands and narrow forested riparian corridors. The Savannah River Site provides nearly 73,250 ha (181,000 acres) of contiguous forested cover broken only by unpaved secondary roads, transmission line corridors, and a few paved primary roads. Carolina bays, the Savannah River swamp, and several relatively intact longleaf pine-wiregrass communities make important contributions to the biodiversity of the region.

The Savannah River Site is near the transition area between the oak-hickory-pine forest and the southern mixed forest. As a consequence, species typical of both associations occur (Dukes, 1984). A variety of vascular plant communities occur in the upland areas. Typically, scrub oak communities occur on the drier, sandier areas. Longleaf pine, turkey oak, bluejack oak, blackjack oak, and dwarf post oak dominate these communities, which typically have understories of wire grass and huckleberry. Oak-hickory hardwood communities occur on more fertile, dry uplands, and characteristic species are white oak, post oak, southern red oak, mockernut hickory, pignut hickory, and loblolly pine, with an understory of sparkleberry, holly, greenbriar, and poison ivy (DOE, 1995c).

The Savannah River Site has provided excellent habitat to wildlife associated with the wetlands of the Savannah River and the pine-dominated sandhills of coastal South Carolina. Furbearers such as gray fox, raccoon, opossum and beaver are relatively common throughout the Savannah River Site. Game species such as gray and fox squirrel, cottontail rabbit, and wild turkey are also common. The Savannah River Site contains suitable habitat for white-tailed deer and feral hogs, as well as other faunal species common to the mixed pine/hardwood forests of South Carolina.

The Savannah River Site has extensive, widely distributed wetlands, most of which are associated with floodplains, creeks, and impoundments. The southwestern Savannah River Site boundary adjoins the Savannah River for approximately 32 km (20 mi). The river floodplain supports an extensive swamp, covering about 4,916 ha (12,148 acres) of the site. At present, the swamp forest consists of second-growth bald cypress, black gum, and other hardwood species (USDA, 1991). Five major streams drain the Savannah River Site, and eventually flow into the Savannah River. Each stream has floodplains characterized by bottomland hardwood forests or scrub-shrub wetlands in varying stages of succession. Dominant species include the red maple, box elder, bald cypress, water tupelo, sweetgum, and black willow (DOE, 1995c). Carolina bays, unique wetland features of the southeastern United States, are islands of wetland habitat dispersed throughout the uplands of the Savannah River Site. The more than 200 bays on the site exhibit extremely variable hydrology and a range of plant communities from herbaceous marsh to forested wetland (Shields et al., 1982; Schalles et al., 1989).

Threatened, Endangered, and Candidate Plant and Animal Species: Threatened, endangered, and candidate plant and animal species on the Savannah River Site include 5 bird species, 1 mammal species, 5 amphibian species, 5 reptile species, 1 fish species, 2 invertebrate species, and 19 plant species. The following Federally listed endangered animals are known to occur on the Savannah River Site or in the Savannah River adjacent to the site: the red-cockaded woodpecker, the southern bald eagle, the wood stork, and the shortnose sturgeon (DOE, 1995c). Researchers have found one Federally listed endangered plant species, the smooth coneflower, on the Savannah River Site, along with several Federally listed Category 2 species, and several listed species (Knox and Sharitz, 1990).

3.3.1.6 Land Use

The Savannah River Site occupies an area of approximately 800 km^2 (310 mi^2) in western South Carolina, in a generally rural area about 40 km (25 mi) southeast of Augusta, GA. The Savannah River Site, which is bordered by the Savannah River to the southwest, includes portions of Aiken, Barnwell, and Allendale

Counties. Land use on the Savannah River Site can be grouped into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Ninety-six percent of the Savannah River Site area, about 73,450 ha (181,500 acres), is undeveloped (USDA, 1991). Approximately 90 percent of this area is forested (Cummins et al., 1990). In 1972, DOE designated the Savannah River Site as a National Environmental Research Park. At present, approximately 57 km^2 (22 mi^2), or 7 percent of the Savannah River Site area is designated as "Set-Asides," which are areas specifically protected for environmental research activities that are coordinated either through the University of Georgia Savannah River Ecological Laboratory or the Savannah River Technology Center (Cummins et al., 1990). At present, administrative production and support facilities occupy approximately 5 percent of the total the Savannah River Site land area.

Land bordering the Savannah River Site is primarily forest and agricultural. There is also a significant amount of open water and forested wetlands along the Savannah River Valley. Urbanized and industrial areas are the only other significant use of land in the vicinity (Figure 3-47). None of the three counties in which the Savannah River Site is located has zoned any of the site land. The only adjacent area with any zoning is the Town of New Ellenton, which has two zoning categories for lands that bound the Savannah River Site, urban development and residential development. The closest residences to the Savannah River Site boundary include several within 61 m (200 ft) of the site perimeter to the west, north, and northeast.

The Savannah River Site is a controlled area, with public access limited to through traffic on South Carolina Highway 125 (the Savannah River Site Road A), U.S. Highway 278, the Savannah River Site Road 1, and the CSX railway. The Savannah River Site does not contain any public recreation facilities. However, the Savannah River Site conducts controlled deer and feral hog hunts each fall, from mid-October through mid-December. The intent of the hunts is to control the resident populations of these animals and to reduce animal-vehicle accidents on the Savannah River Site roads.

3.3.1.7 Noise

The major noise sources at the Savannah River Site are found primarily in developed operational areas, and include various facilities, equipment, and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise sources outside the operational areas consist primarily of vehicles and railroad operations. Previous studies have analyzed noise impacts of existing the Savannah River Site operational activities (DOE, 1995c; DOE, 1991a; DOE, 1990a; DOE, 1993d). These studies concluded that, because of the remote locations of the Savannah River Site operational areas, there are no known conditions associated with existing onsite noise sources that adversely affect individuals at offsite locations. Some disturbance of wildlife activities might occur on the Savannah River Site as a result of hunting activities and construction activities. Noise limits are established for the workplace to protect workers' hearing in accordance with Occupational Health and Safety Administration standards. Existing Savannah River Site-related noise sources of importance to the public are those associated with the transportation of people and materials to and from the site. These sources include trucks, private vehicles, and freight trains. In addition, a portion of the air cargo and business travel using commercial air transport through the airports at Augusta, GA, and Columbia, SC, is attributable to the Savannah River Site operations. The States of Georgia and South Carolina, and the counties in which the Savannah River Site is located, have not established regulations that specify acceptable community noise levels, with the exception of a provision of the Aiken County Nuisance Ordinance, which limits daytime and nighttime noise by frequency band (Aiken County, 1991).

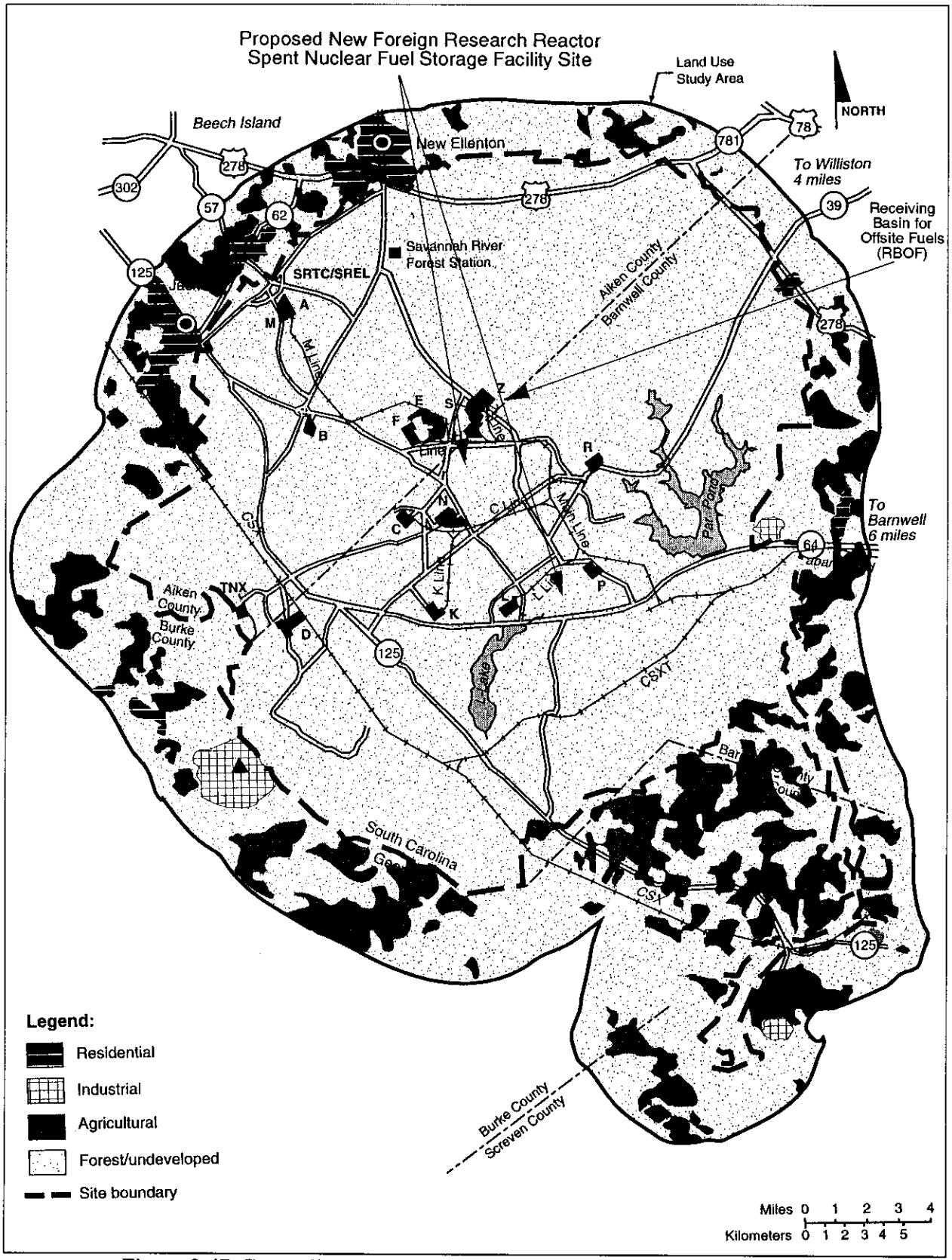

Figure 3-47 Generalized Land Use at the Savannah River Site and Vicinity

Noise from the Savannah River Site Traffic: During a normal week, about 20,000 employees travel to the Savannah River Site each day in private vehicles from surrounding communities. Both Government-owned and private trucks pick up and deliver materials at the site. The contribution of the Savannah River Site operations to traffic volumes along SC 125 and SC 19, especially during peak traffic periods, affects noise levels in the towns of New Ellenton and Jackson and the city of Aiken. Noise measurements taken during 1989 and 1990 along SC 125 in the town of Jackson (at a point about 15 m or 50 ft from the roadway) indicate that the one-hour equivalent sound level from traffic ranged from 48 to 72 decibels. The estimated day/night average sound level along this route was 66 decibels for summer and 69 decibels for winter. Similarly, noise measurements along SC 19 in the town of New Ellenton indicate that the one-hour equivalent sound level from traffic ranged from 53 to 71 decibels. The estimated day/night average sound level along this route was 66 decibels for both summer and winter (HNUS, 1990). Employment at the Savannah River Site has increased by about 17 percent since 1989, potentially causing increases in traffic noise, especially during peak traffic periods (approximately between 6:30 and 8:30 a.m., and between 3:30 and 5:30 p.m. corresponding to major shift changes). Since some residences and at least two schools are within 30 to 60 m (100 to 200 ft) of these routes, some annoyance to members of the public residing along these highways can occur based on the relationship between the day/night average sound level (Schultz 1978; FICON, 1992).

Noise from Railroad Traffic: Approximately 18 trains per day pass through the Savannah River Site on the CSX line, with five trains delivering shipments to the Savannah River Site. Noise sources from rail transport include diesel engines, wheel-track contact, and whistle-warnings at rail crossings.

3.3.1.8 Transportation

The Savannah River Site is surrounded by a system of Interstate highways, U.S. highways, State highways, and railroads. The regional transportation networks service the four South Carolina counties (Aiken, Allendale, Bamberg, and Barnwell), and two Georgia counties (Columbia and Richmond) that generate about 90 percent of the Savannah River Site commuter traffic (DOE, 1995c). Two major railroads—CSX Transportation and Norfolk Southern Corporation—also serve the Savannah River Site vicinity. Norfolk Southern serves Augusta and Savannah, GA, as well as Columbia and Charleston, SC. CSX serves the same locations and the Savannah River Site. Figure 3-48 shows the regional transportation infrastructure.

Two Interstate highways serve the Savannah River Site area. Interstate 20 (I-20) provides a primary east-west corridor and I-520 links I-20 with Augusta, GA. U.S. Highways 1 and 25 are principal north-south routes, and U.S. 78 provides east-west connections. Several other highways (U.S. 221, U.S. 301, U.S. 321, and U.S. 601) provide additional transport routes in the region. Several State routes provide direct access to the Savannah River Site. From the northwest and north, access is provided by SC 125 and SC 19, respectively, and SC 125 is open to through traffic. Access to the site is provided from the northeast by SC 39, from the east by SC 64, and from the southeast by SC 125. These are all two-lane roads. The public has access to U.S. 278 and SC 125, but only the Savannah River Site employees are permitted access to the site on the other routes.

The Savannah River Site transportation infrastructure consists of more than 230 km (143 mi) of primary roads, 1,931 km (1,200 mi) of unpaved secondary roads, and 103 km (64 mi) of railroad track (DOE, 1995c). These roads and railroads provide connections among the various Savannah River Site facilities and offsite transportation linkages. Figure 3-49 shows the Savannah River Site network of primary roadways and access points, and the Savannah River Site railway system.

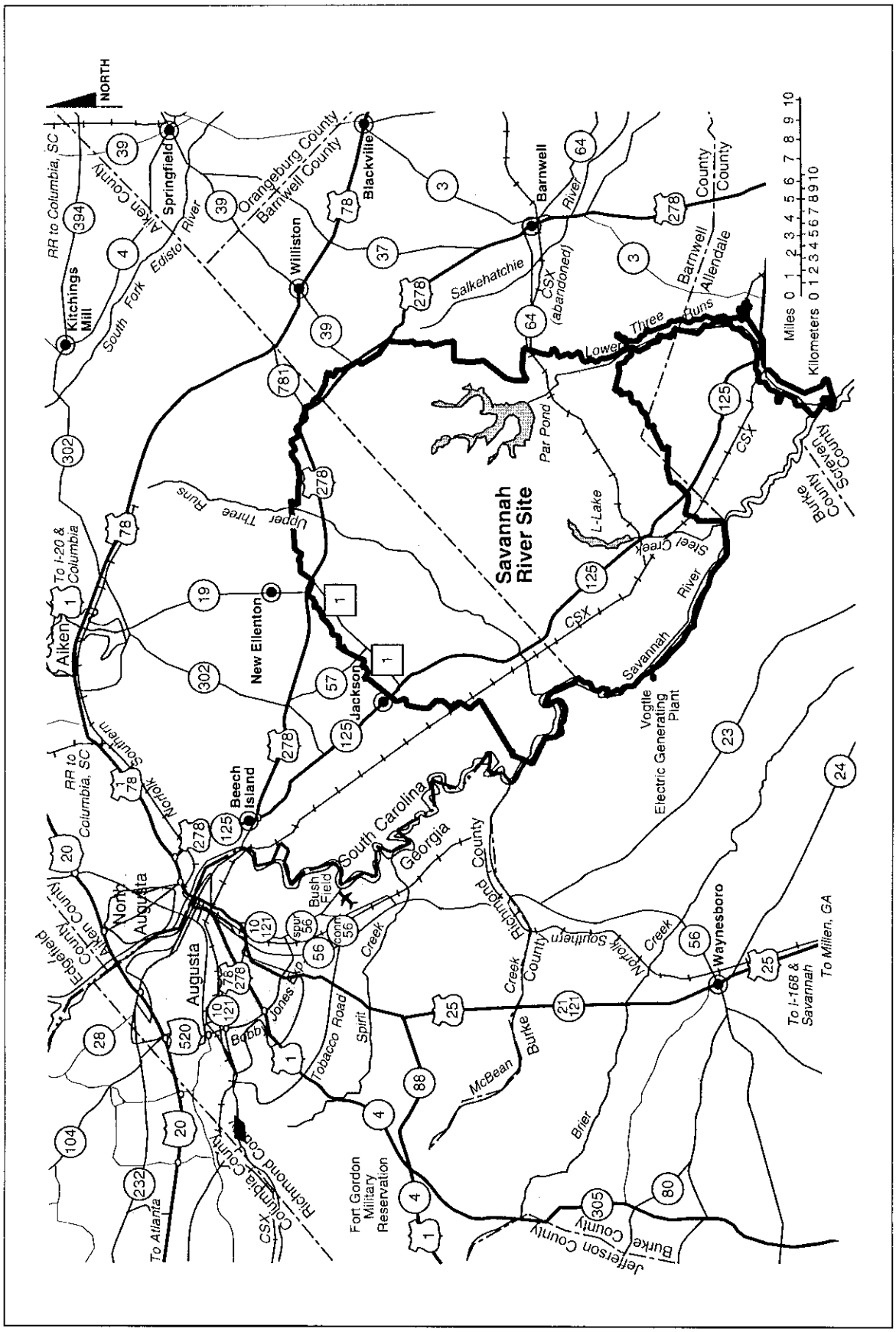

Figure 3-48 Regional Transportation Infrastructure

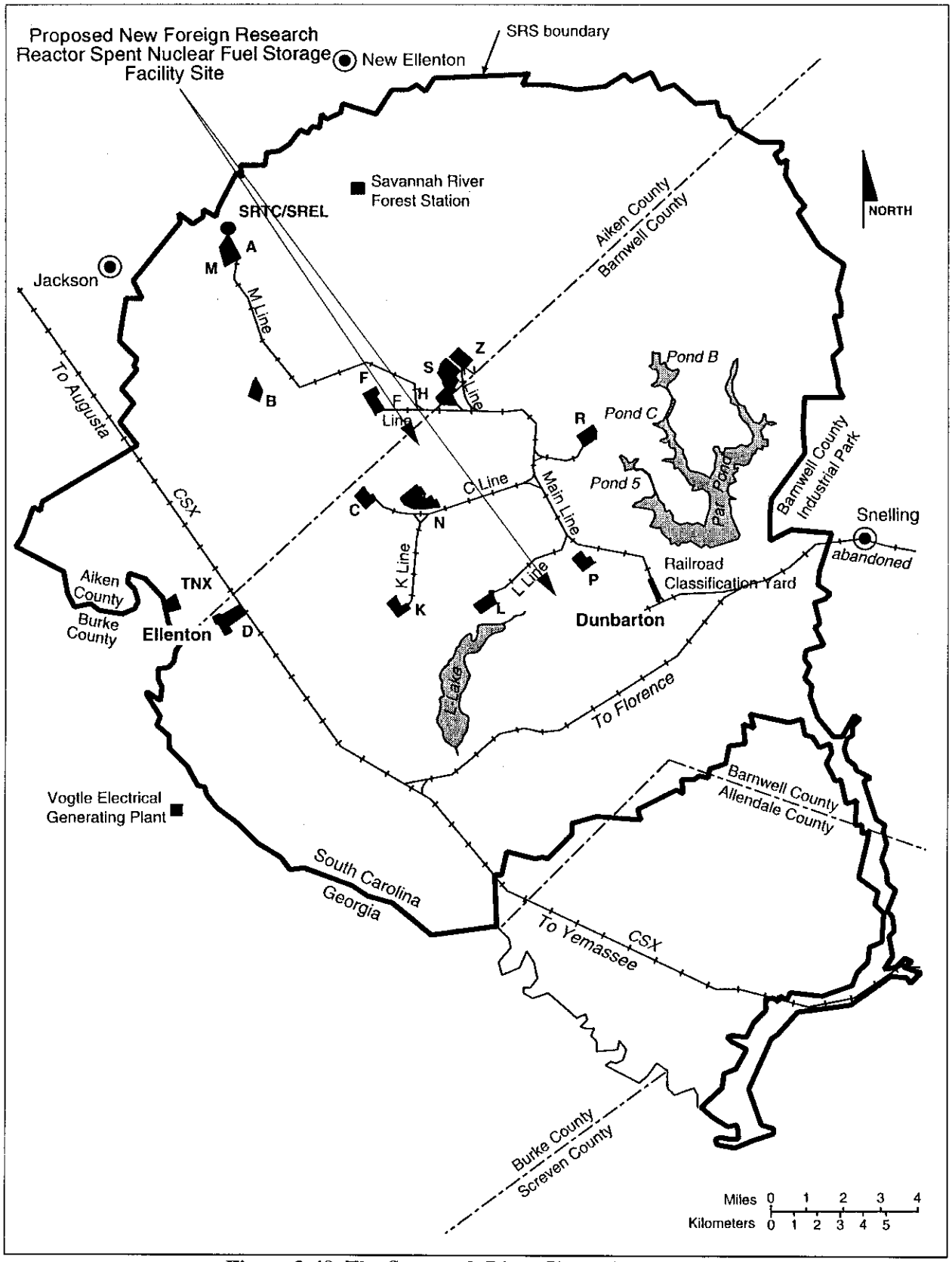

Figure 3-49 The Savannah River Site Railroad Lines

Two major public highways traverse the Savannah River Site: SC 125 and U.S. 278. SC 125 connects Allendale, SC, to Augusta, GA, by crossing the site in a northwest-to-southeast direction. U.S. 278 also connects Augusta and Allendale, but its route generally follows the northern and eastern Savannah River Site boundaries. In general, the primary Savannah River Site roadways are in good condition, and are smooth and free from potholes. Typically, wide, firm shoulders border roads that are either straight or have wide gradual turns. Intersections are well marked for both traffic and safety identification, and are sufficiently cleared of trees and brush that might obstruct a driver's view of oncoming traffic. Railings along the side of the roadways offer protection at appropriate locations from dropoffs or other hazards. In general, the roadways are lighted only at gate areas and near major facilities.

In general, heavy traffic occurs early in the morning and late in the afternoon when workers from surrounding communities commute to and from the Savannah River Site. During working hours, official vehicles and logging trucks constitute most of the traffic. At any time, as many as 60 logging trucks, which can impede traffic, might be operating on the Savannah River Site, with an annual average of about 25 trucks per day. Table 4-16 of Appendix C, Volume 1 of the Programmatic SNF&INEL Final EIS provides data on traffic counts for various roads and access points around the Savannah River Site (DOE, 1995c).

Railroads on the Savannah River Site include both CSX tracks and the Savannah River Site rolling stock and tracks. Two routes of the CSX distribution system run through the Savannah River Site: a line between Florence, SC, and Augusta, GA, and a line between Yemassee, SC, and Augusta. The two lines join on the site near the L-Lake dam (Figure 3-49). Early in 1989, CSX discontinued service on the line from the Savannah River Site junction to Florence. The 103 km (64 mi) of the Savannah River Site railroad tracks are well maintained. The rails and crosslines are in good condition, and the track lines are clear of vegetation and debris. Significant clear areas border the tracks on both sides. Intersections of railroads and roadways are marked by railroad crossing signs with lights where appropriate. The Savannah River Site rail classification yard is east of P-Reactor. This eight-track facility sorts and redirects railcars. Deliveries of the Savannah River Site shipments occur at two onsite rail stations at the former towns of Ellenton and Dunbarton. From these stations, a Savannah River Site engine moves the railcars to the appropriate receiving facility. The Ellenton station, which is on the main Augusta-Yemassee line, is the preferred delivery point. The Dunbarton station, which is on the discontinued portion of the Augusta-Florence line, receives less use.

3.3.1.9 Socioeconomics

The Savannah River Site region of influence includes Aiken, Allendale, Bamberg, and Barnwell Counties in South Carolina, and Columbia and Richmond Counties in Georgia. Between 1980 and 1990, total employment in the region of influence increased from 139,504 to 199,161, an average annual growth rate of approximately 5 percent. Table 4-1 of Appendix C, Volume 1 of the Programmatic SNF&INEL Final EIS lists projected employment data for the six-county region of influence. As shown, by the year 2000, employment levels should increase 27 percent to approximately 253,000. The unemployment rates for 1980 and 1990 were 7.3 percent and 4.7 percent, respectively (DOE, 1995c).

In 1990, employment at the Savannah River Site was 20,230, representing 10 percent of the region of influence employment (DOE, 1993d). In Fiscal Year 1992, employment at the Savannah River Site increased approximately 15 percent to 23,351, with an associated payroll of more than $1.1 billion. From 1980 to 1990, the labor force in the six-county region of influence grew 39 percent, from 150,551 to 208,984. In 1990, 75.3 percent of the region of influence labor force lived in Richmond and Aiken Counties, SC. Current projections call for the region's labor force to increase to approximately 257,000 workers by 1995 (DOE, 1995c).

Between 1980 and 1990, population in the region of influence increased 13 percent, from 376,058 to 425,607. More than 88 percent of the 1990 population lived in Aiken (28.4 percent), Columbia (15.5 percent), and Richmond (44.6 percent) Counties. According to 1990 census data, the estimated average number of persons per household in the six-county region was 2.72, and the median age of the population was 31.2 years (DOE, 1995c). Based on 1990 census population data, the general ethnic composition of the immediate area of influence, which is within an 80 km (50 mi) radius of the site, is shown in Figure 3-50. Low-income households are presented in Figure 3-51. Low-income households are those with incomes of 80 percent or less than the median income of the counties. As indicated in this figure, approximately 42 percent of the total households are low-income households.

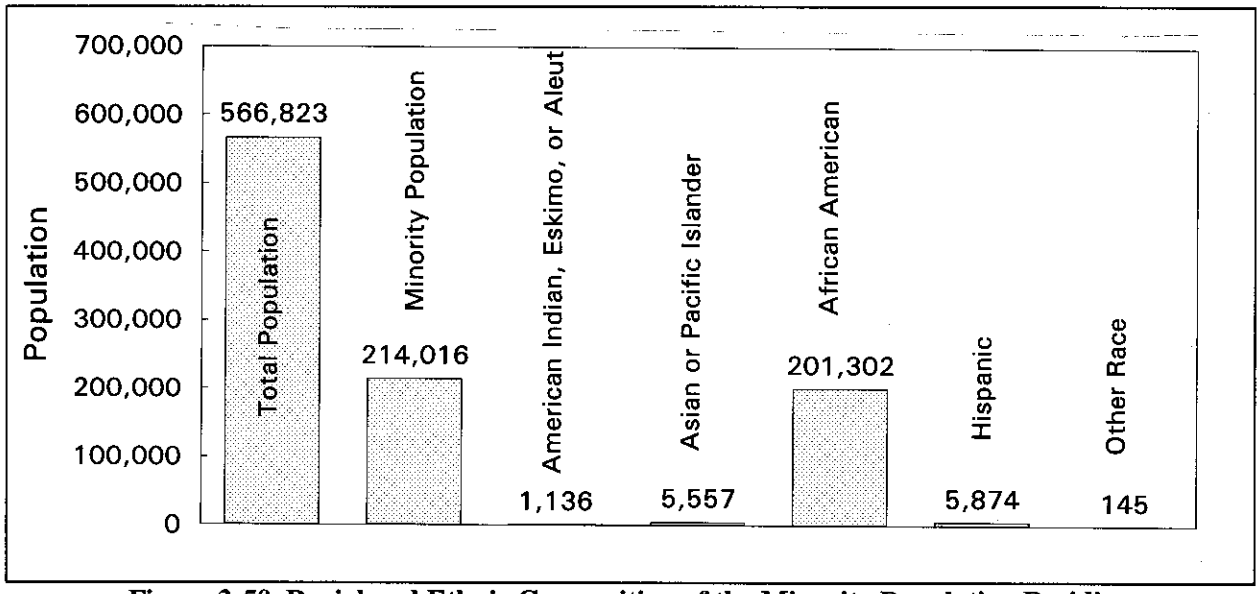

Figure 3-50 Racial and Ethnic Composition of the Minority Population Residing within 80 km (50 mi) of the Savannah River Site

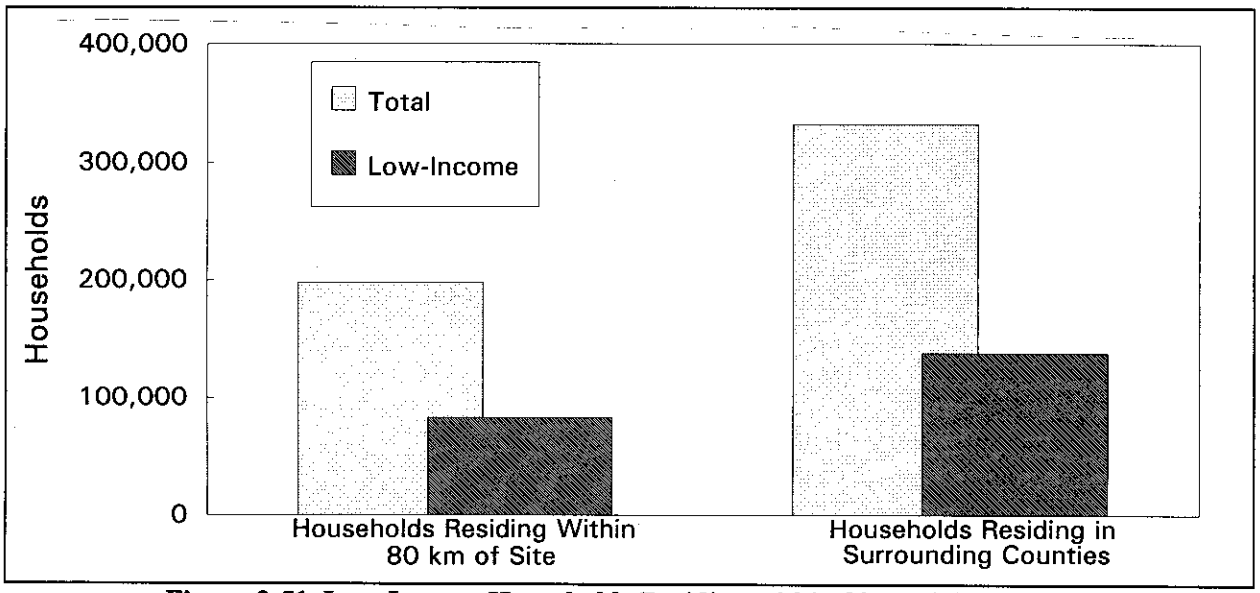

Figure 3-51 Low-Income Households Residing within 80 km (50 mi) of the Savannah River Site